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CONTENTS

	Page
Limitations of Planning	41
The Mathematical Principles of Physics. By Dr. R. Fürth	44
Essays on Economic Recovery	45
Science and Philosophy. By Dr. A. C. Crombie	46
A Guide to the Astrolabe. By Dr. F. Sherwood Taylor	46
Public Health To-day. By Sir Arthur MacNalty, K.C.B.	47
Nature Lover and Fisherman. By Seton Gordon, C.B.E.	48
Organic Substances used in Inorganic Analysis. By Dr. G. M. Bennett, F.R.S.	48
The Ronald Ross Jubilee	50
The Post Office Research Station	51
Land and Poverty in the Middle East. By Dr. B. A. Keen, F.R.S.	53
The Medical Nobel Institutes, Stockholm	54
Colour Terminology. By Dr. W. S. Stiles, O.B.E.	54
News and Views	55
Letters to the Editors :	
Antibiotics Produced by Fungi, and a New Phenomenon in Optical Resolution.—Dr. A. H. Cook, S. F. Cox and T. H. Farmer	61
The Antibiotic Agent from *Marasmius ramealis*.—Gerd Bendz, Gösta Wallmark and Karin Öblom	61
Utilization of Mineral Constituents of the Egg-shell by the Developing Embryo of the Stick Insect.—A. Moscona	62
Function of Hyaluronidase in Fertilization.—C. R. Austin	63
Metabolism of Aminohydroxybenzoic Acids.—Dr. H. G. Bray, Brenda E. Ryman and Dr. W. V. Thorpe	64
Lipoid Content of the Oxyntic Granules of the Rat's Stomach.—Gordon Menzies	64
Discriminating 'Athrocytes' in the Reticulo-endothelial System.—Dr. J. Lison and J. Smulders	65
A Further Example of the Anti-S Agglutinin.—Dr. M. M. Pickles	66
Variations in Spermatogenesis of Oligospermic Men.—Margaret Hadley Jackson and Clare Harvey	67
Relation Between Fountain Pressure and Heat Current in Helium II.—Lothar Meyer and William Band	67
High-Frequency Resistance of Superconductors.—A. B. Pippard	68
Oxidation of Uranium Dioxide (UO_2).—Fredrik Grønvold and Prof. Haakon Haraldsen	69
Crystal Structure of Uranium Oxide (U_4O_9).—Fredrik Grønvold	70
Structure of Abraded Surfaces.—J. B. Dance and D. J. Norris	71
Crystal Structure of Acetanilide : Use of Polarized Infra-Red Radiation.—Dr. C. J. Brown and D. E. C. Corbridge	72
Structure of Citrinin.—J. P. Brown, N. J. Cartwright, Prof. A. Robertson, F.R.S., and W. B. Whalley	72
Nitration of Simple Heterocycles.—David W. Mathieson and A. McCoubrey	73
Production of Quinolyl and Pyridyl Anions during Decarboxylation.—B. R. Brown, Dr. Ll. Hammick and B. H. Thewlis	73
Ecology of Sponges.—Dr. Maurice Burton	73
Neurotic Behaviour in Ants.—Derek Wragge Morley	74
Distribution of Lugworms.—Dr. G. E. Newell and Garth Chapman	75
Life-History of *Splachnidium rugosum*.—R. J. Hopkins	75
A Method of Distinguishing between Young and Old Colorado Beetles.—E. Dunn	75
Golgi Apparatus of Living Human Testicular Cells seen with Phase-Contrast Microscopy. By A. G. Oettlé	76
Permeability of the Membranes of the Hen's Egg. By Prof. N. Klisziunis	77
Excavations of a Roman House	78
South-Eastern Union of Scientific Societies : Annual Congress, 1948	78
Smithsonian Institution : Annual Report	79

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LIMITATIONS OF PLANNING

OF the many repercussions in Britain of the fuel crisis of February 1947, the shock administered to the general belief in economic planning was among the most far-reaching. Those who then began to doubt whether the best way of ordering economic affairs was to place the responsibility for all crucial decisions in the hands of the State have since been joined by many others as a sequel to the balance of payments crisis of August. Behind the resentment originally aroused by the abolition of the basic petrol ration and the direction of labour lies uneasiness as to whether the method of cure is not bringing evils worse than the disease, and endangering precious and fundamental elements of our heritage of freedom.

This is no mere party issue, and while it may still be generally admitted that we must have more State intervention and direction in our economic life than we had before the War, there is probably less disposition to regard economic planning as a magic talisman by which our difficulties may be charmed away. The recent resignation of Sir Charles Reid from the National Coal Board arouses profound misgivings as to whether under the existing conditions the technical man will be allowed to make his all-important contribution to the improvement of technical efficiency and production. Those who believed that, given time, good technique might solve the worst of Britain's coal problems, are forced to admit that mining engineers, at the moment, are not in a position to make their full contribution to the rehabilitation of the industry.

If this is true in the coal industry, nationalization of which was accepted by almost everyone as essential and appropriate, doubts cannot but grow whether the programme of nationalization will make any positive contribution to the improvement of industrial efficiency and productivity, either in the narrower technical or in the wider social and economic context. While the recommendations of the Reid Report are not implemented, the scientific worker and the technologist at least can scarcely be convinced that nationalization as such is the answer to our economic problem, if indeed they do not see in national ownership a fresh obstacle to the technical reorganisation which may be needed in more than one industry. Those doubts will be further strengthened by the opinions voiced by Sir John Henry Woods, 'permanent secretary' to the Board of Trade, in a lecture before the Institute of Public Administration last December. Indeed, that lecture, now published in the *Journal of Public Administration* (**26**, 85 ; 1948), contains unmistakable evidence that nationalization of industry in Britain at the pace set by the present Government has seriously overstrained the administrative resources of the country, as indeed both Mr. Shinwell and the Lord President of the Council have admitted.

Despite, therefore, current discussions on the possibilities of securing a better utilization of the country's resources of scientific man-power through planning based on operational research, there is probably a much wider disposition than at any time

since the end of the War to recognize that central planning has limits. That much was argued by Sir Oliver Franks in the very lectures to the London School of Economics and Political Science last year which Sir Hubert Henderson criticized in his Rede Lecture in May 1947. The question to-day is rather where is the frontier to be drawn between planning and freedom, given the techniques now at our disposal, the administrative possibilities and difficulties, and the social aspirations which lie behind so much of the programme of reconstruction to which the present Government no less than its predecessor is committed.

Prof. John Jewkes' recent book, "Ordeal by Planning"*, shows plainly that discussion is what is first required. Readable, fluent and clear in its diagnosis, it says much that was worth saying and will be read with approval by many who are becoming conscious that they are losing something they cherish and in danger of losing more. But its analysis is purely destructive, and Prof. Jewkes has thrown away an opportunity all the greater because the persuasiveness and clarity of his style should secure a firm hold on the reader's sympathy and understanding. He defends himself, it is true, on the plea that it is necessary to clear a field of weeds before sowing a new crop; but sometimes his destructive analysis is more like pulling up the wheat with the tares and handing over both to the destructor. Nevertheless, it is well that the relation should be established between the fall in the standard of living in Britain, the progressive restrictions on individual liberties, the ever-widening destruction of respect for law, the steady sapping of our instinct for tolerance and compromise, the sharpening of class distinctions and our growing incapacity to play a rightful part in world affairs; though it is going too far to attribute these interrelated changes to something that has happened in the last two years. The danger of liberties being filched away, of the residue of our liberal traditions disintegrating and a planned economy issuing in totalitarianism are plainly stated, but it does not follow, as Prof. Jewkes implies, that we must choose between further planning and a return to the free price mechanism.

It is, however, when he comes to discuss planning as a scientific method, planning and freedom and planning and prosperity, that Prof. Jewkes has most to say that is of direct interest to the scientific worker. Under the first heading his remarks bear closely on the organisation and activities of the nationalized industries and are given point by Sir Charles Reid's resignation and by the inability of members of Parliament to raise a question in the House of Commons regarding a recent widespread failure in power supply. The purely logical and intellectual difficulties of running a planned economy have not yet been solved, though it is pessimistic to assume as yet that they cannot be solved. Prof. Jewkes maintains, however, that central economic planning cannot be scientific. In the first place, he says, such a plan can only have a scientific purpose if it is designed to give the consumers what they want and when they want it, and to provide freedom for the consumer to decide whether he wishes to spend his money now or in the future. In the second place, the centrally planned economy is unscientific in that those who take the final decisions must always avoid the confession of failure.

It may be true that in practice the central planner does tend to avoid admitting failure, but nevertheless Prof. Jewkes' 'must' can well be challenged; similarly, the fact that central planners have often disregarded the consumers is no valid reason for asserting that they must necessarily fail to provide the consumer with the freedom on which Prof. Jewkes quite correctly insists. Here as elsewhere Prof. Jewkes indicates the essential criteria for freedom; but, pointing to present failures to meet those criteria, concludes rather too readily that they can never be met. It is well that those weaknesses should be stressed. Britain clearly is ill able to afford the waste of man-power and materials that are inherent in some of the manifestations of planning we are at present witnessing. It is not merely the growth of the administrative staff or bureaucracy. The danger of retarded technical progress, and the deterioration of the atmosphere in which fundamental research is prosecuted to which Prof. Jewkes refers cannot be ignored, and should be seriously considered.

We have to remember that in the last analysis the answer to the problem depends upon which type of economic organisation will provide the greatest incentive to effort. Prof. Jewkes points out that whether planning can evoke sufficiently powerful incentives to enable it to match the economic results of a free economy depends upon many physical, psychological and even spiritual factors bound up with the reasons why men work at all. These factors are complex and difficult to assess; but Prof. Jewkes suggests that there are two groups of workers whose output is likely to be affected adversely in the planned economy of a socialist State. The first, and larger, is that which presses for socialism in the expectation that it will lead to an easier life and bigger returns for less effort. The second and more important group is that responsible for the highest intellectual effort, such as fundamental scientific research.

Prof. Jewkes believes that fundamental research must wither in a planned economy, both because it cannot proceed in such an environment and because those who are capable of it will be disgruntled by what appears to them the foolish policy of the State in failing to provide the only environment in which they can work. He cites in support of this view the wholesale resignation of the experts on jet propulsion when the Government took over this research; and while he is here on debatable ground, the importance of incentives in this context cannot be gainsaid. It must be admitted that the whole question requires very careful examination, for there is no doubt that under present conditions the real work of the world —the patient fostering of the efficient organisation of a factory, the cultivation of craftsmanship, the extending of scientific knowledge, the teaching of the young, the healing of the sick—does tend to fall in

* Ordeal by Planning. By Prof. John Jewkes. Pp. xi + 248. (London: Macmillan and Co., Ltd., 1948.) 12s. 6d. net.

public esteem. Moreover, there is continuous erosion or destruction of the sense of responsibility, and this may be quite as serious in its results as the decrease in the differentials in reward in a planned as compared with a free economy.

Prof. Jewkes argues that the planned and centrally directed economy must inevitably undermine the economic freedoms, such as the choice of occupation, the disposal of incomes and the acquisition and tenure of property. These freedoms, while they can never be absolute, cannot be separated from the freedom of expression in all its forms or the freedom to choose and change the members of the governing body of the community, and their whittling away destroys the independent thought and criticism through which alone freedom can be preserved. However strongly we may feel that Prof. Jewkes is too pessimistic here, the danger is real; and it is well that we should be asked to consider more carefully how it is that planning, which sets out to control things, ends by controlling men.

Prof. Jewkes' argument is strongest at this point, where it directs attention to the dangers to man's moral and spiritual welfare which appear to be inherent in economic planning. Wherever the frontier is drawn between freedom and planning, the organisation we establish to serve the needs of society with the most effective techniques and administrative resources of to-day must take full account of them; we must never forget that the individual is more important than the organisation or plan designed to serve his needs.

This warning of the danger of over-organisation and of central planning is emphasized from another point of view by the lecture by Sir John Woods on the administrative problems of the Board of Trade; Sir John is frankly concerned as to whether the central machine of Government can stand for long a continuance of the pressure, and his lecture underlines all that was urged by the Select Committee on Estimates in its Fifth Report for the Session 1946–47, and by Prof. W. A. Robson in his article on "Machinery of Government, 1939–1947" in the *Political Quarterly* early this year and again in his inaugural lecture at the London School of Economics and Political Science, on the urgent necessity of reconsidering the whole pattern of the Government machine in the light of modern conditions. In particular, Sir John asks whether the work of the Board of Trade as it now stands is a business that can be administered at all; and the whole trend of his lecture suggests that the answer is that it cannot. The trouble is generally congestion at the top, because in spite of the expansion of government departments the structure remains essentially one that was built up for much lighter and more leisurely tasks. The Board of Trade provides an excellent illustration of the position, but it also illustrates very forcibly one of the points Prof. Jewkes makes. In 1938 the Board of Trade had a staff of 2,400, of whom 60 were administrative officers: there are now 400 administrative officers and a total staff of 15,000. The main divisions of its work are in charge of fifteen 'under-secretaries', above whom are two 'second secretaries' and the 'permanent secretary', through whom theoretically all important questions pass to the president of the Board of Trade.

When the department was small, this system was a practical means of seeing that its policy as a whole was coherent; now it is what Sir John calls a 'super-bottleneck', and in practice it is not possible for everything to go to the president through the permanent secretary. Nevertheless, it is essential to keep in step the policies of some four hundred people, and in spite of all the elaborate methods already adopted to inform each section of what the others are doing, the range of activities is so wide that Sir John admits that it is still possible for somebody to go ahead with a policy only to find that it conflicts with some other line of policy being pursued elsewhere. The administrative confusion and public criticism which result involve further waste of time on remedial measures, and lead to an even greater danger: so much time is spent in being sure of keeping in step that advance is scarcely possible. In Sir John's words, "things that ought to happen do not happen while we are making sure that nobody will be upset if they do happen".

In this great department, the essential function of research or fact finding as a basis for the determination of long-range policy as distinct from day-to-day activities is not being discharged. It should also be remembered that even if we could find the able men outside the Civil Service to serve on a committee to investigate such matters, Civil servants would still have to collect the information. Whatever Prof. Jewkes may urge, and although the Government could avoid making fresh demands on the Civil Service and perhaps reduce some of the present demands, most of the work has come to stay.

Such observations emphasize the importance of such new ventures as the British Institute of Management and the Administrative Staff College, as well as the National Institute of Economic and Social Research, and the increased provision for research in social science at the universities recommended by the Clapham Committee. The training and exchange of staff, and research into problems of administration and government, will both be required before we can either evolve the most effective forms of organisation to serve our needs to-day in industry and in government, or say with certainty where the frontier between planning and freedom lies. The conclusion to be drawn from Prof. Jewkes' book, with its demonstration of the dangers and abuse of planning, is not that planning is impracticable, but rather, as Sir John's lecture indicates, that we have embarked on large schemes of planning and organisation before determining the nature of the organisation required, the precise purposes it has to serve and the limitations imposed by existing techniques and administrative ability, whether individual or collective.

This fresh warning of the dangers of planning and reminder that for the moment we have outstripped our administrative resources and capacity for organisation is really a challenge to creative thought and to fresh efforts to discover the ways of co-operation in which the vast material resources which technology

has put at our command may be used for the benefit of the whole community. Whatever mistakes may have been made in planning—and they have been frequent and grievous—mankind cannot go back and abdicate the conscious control of his environment. The preservation of the rich cultural and spiritual heritage of mankind, on which Prof. Jewkes rightly lays such stress, depends on fresh advance in the patient study of human relations and institutions, and the evolution on the basis of past experience of new means to serve the more complex demands of modern society. The price of freedom is indeed eternal vigilance; but a part of that price must be the continuing, courageous and imaginative study of human organisation, inspired by a greater respect for human personality and the moral values of Western civilization.

THE MATHEMATICAL PRINCIPLES OF PHYSICS

Principia Physica

Von Hans Georg Küssner. Pp. 256. (Göttingen: Vandenhoeck and Ruprecht, 1946.) n.p.

IN this book the author presents a new conception of the general principles of physics by trying to construct an axiomatic system in which no descriptions of facts are used which are not "logically definable". Maintaining that the notion of the continuum does not fulfil this condition, he demands that metric geometry be excluded from physics altogether, and that the space-time system be put on a purely arithmetical basis. In other words, the universe is considered to be a discontinuous manifold or point lattice. Quaternion algebra is found to provide the most adequate mathematical description for such a system and to account automatically for the four-dimensionality of space-time and its splitting up into three space-like and one time-like dimensions. In contrast to the usual concept of a dynamic universe to be described by events, the new concept is that of a static universe to be described by its structure, which reflects itself in the group properties of the algebra used for this description. Accordingly, the fundamental laws of physics cannot have the form of differential equations but have to be expressed in the form of integral equations, that is, free of metric, the integrals used being essentially Stieltjes integrals, the definition of which also holds for a discrete set of variables.

These integrals extend over the whole space-time, which is in keeping with the fact that in classical physics both time directions are completely equivalent and that there is no actual difference between past and future. On the other hand, the classical concept of causality, namely, that the future as well as the past of a physical system ought to be completely predictable from a knowledge of its present state, is not compatible with this structural idea, as no exact statement at all can be made about the structure outside a certain finite region of the world lattice from a mere knowledge of the structure within. Thus only approximate extrapolations can be made, which is essentially the same as saying that in general only statistical statements about the future (or the past) of a physical system are possible. Quantum mechanics, which is of an intrinsically statistical nature, is therefore regarded by the author as only an approximation towards the real structural laws. The general theory of relativity is also rejected because it is essentially based on metric geometry.

The world (lattice) points can be classified in different ways. A class of points constituting a line of sufficient length is identified with an 'atom'. Thus the atoms have no geometrical structure and have the character of 'point charges', the charges being of two different types, electric and 'gravic', and of different magnitude. All atoms can be classified into classes of equal charge, and by the application of group theoretical arguments it is shown that only a finite number of such classes exist. Each atom is in integral interaction with every other atom. The laws of this interaction, which are the equivalent of the classical field laws of electromagnetism and gravitation, are supposed to be of the type of Maxwell's equations which, it is shown, can be formulated as integral equations of the above-mentioned character. These equations also comprise interactions between electric and gravic charges which, the author claims, are the explanation for the electric and magnetic fields of the stars. Experiments for the verification of these relations are proposed.

The principles mentioned so far cover the domain of physical laws in medium dimensions. In order to obtain the laws of macrophysics and microphysics other principles have to be added. In the first case a structural principle relating to the structure of the universe as a whole is formulated, which the author calls the "principle of equal surroundings". This, it is claimed, leads to an understanding of the expansion of the universe and a number of other cosmological phenomena, and it also disposes of the notion of an inertial mass, reducing it to the interaction with the total material content of the universe. The non-commutative quaternion algebra, on the other hand, lends itself to the introduction of quantum conditions in the form of commutation rules. In addition to Planck's constant for the electromagnetic interaction of atoms another constant for the 'gravic' interaction is introduced. This leads to a theory of a new kind of atomic disintegration which is believed to be the origin of the primary cosmic radiation, the extra-terrestrial nature of which the author denies.

The fundamental equations of the new theory contain altogether fifteen universal constants. It is well known that only three such quantities can be dimensionally independent. Hence twelve independent relations between these quantities can be established which contain only dimensionless arithmetical constants. These are identified with the twelve arithmetical group invariants of the particular kind of algebra used. This is put to the test by a comparison between the theoretical and the most reliable experimental values of the universal constants, which indeed shows most striking agreement within the limits of accuracy. Moreover, according to the above-mentioned ideas about the nature of the atoms it should, in the view of the author, be possible also to calculate, by similar methods, the masses and spins of all possible atoms in all states of excitation. The solution of this problem is also attempted but only a limited success is claimed.

Although the author repeatedly emphasizes that all new theoretical ideas must be subjected to the most rigorous tests by experiment, it is nevertheless evident that he is essentially of the opinion that the complete understanding of the material world can be achieved by purely epistemological methods. This

accounts for the frequent appearance of phrases like 'endgültige Erkenntnis' (final cognition). The many extremely close agreements between theory and experiment are presented as stringent evidence for the truth of the theory; but the same claims are made by other theories (like Eddington's) which are based on completely different epistemological principles. In the opinion of the reviewer none of these theories could have been developed without a previous knowledge of the experimental facts and the numerical results of the experiments. Indeed, a great number of recent discoveries about fundamental particles, etc., are definitely not 'predicted' by the theory simply because the author did not know them while developing his ideas. Thus in spite of its extremely interesting aspects the new theory can only be regarded as one of many attempts to restore order and harmony in the rather chaotic state of ideas about the material universe which has its parallel in the state of affairs concerning spiritual values. Every brave effort to achieve unification in both realms of thought is welcome, and therefore the detailed study of the ideas which are briefly outlined in this review can be warmly recommended.

R. FÜRTH

ESSAYS ON ECONOMIC RECOVERY

Britain's Industrial Survival

By Ian Bowen. Pp. 204. (London: Faber and Faber, Ltd., 1947.) 12*s.* 6*d.* net.

Co-operative Communities at Work

By Henrik F. Infield. (International Library of Sociology and Social Reconstruction.) Pp. x + 182. (London: Kegan Paul and Co., Ltd., 1947.) 15*s.* net.

The World as an Economic Entity

By Business and Brotherhood and Res et Caritas. Pp. viii + 218. (Nicosia, Cyprus: Guebenlian Press, 1946.) 7*s.* 6*d.*

WITHIN a decade the concept 'economics' has gone out of vogue and 'political economy' has again taken its place. This is perhaps not so surprising at a time when attention is turned from analysis to application. Mr. Bowen is definitely a political economist; and the use of this self-styled title is evidently a warning not to expect any systematic analysis. His examination of the necessary conditions for Britain's economic recovery unhesitatingly introduces biological and political factors. Indeed, any realistic approach to applied economic problems could scarcely fail to do so. But after having read the book through, the reader might well wonder what the formulation of "the two main world economic problems"—a declining population and unemployment—has to do with the future industrial organisation of Britain, dealt with in the concluding chapter. There is no attempt to analyse fully or assess the relevant problems facing Britain and to reach, through such an analysis, certain conclusions.

The book makes pleasant reading but gives little return for study. Yet despite its two hundred pages it contains quite a wealth of economic information, presented in a rather kaleidoscopic form. There is a good section on distribution and imperfect competition and the devices used to restrain retail competition. There is also an interesting chapter on "Advertising in the Modern Economy", followed by a discussion of monopoly in manufacturing, the application of power to industry, industrial efficiency, the formation of capital, population, and overseas capital formation. Indeed, scarcely any of the chapters are without interest; but they would be improved were they treated as separate papers rather than as steps in a logical argument.

In many respects Mr. Bowen falls between two stools. The study is too factual and too detailed for the ordinary reader and not sufficiently analytical for the student. For example, in the section on the rigidity of retail margins, which is an excellent collection of informative data, it is a pity that it did not include any examination of war-time controls and the method of stabilizing prices which has not only perpetuated the fixed margin concept (and possibly petrified it, too) but also strengthened the position of retail associations. There are many other such examples, where the reader feels the study could have been pushed deeper. But this criticism at least shows that Mr. Bowen's writing provokes thought and discussion.

There are some illuminating statistics gleaned from various sources, but again one feels—possibly quite unjustifiably—that many of the correlations are perhaps just statistical freaks. Nevertheless Mr. Bowen's discussion of the organisation of the national boards makes amends. His comments are sound and his emphasis on joint consultative machinery in industry is correct, although one cannot help thinking that under his proposed organisation the influence of the State would penetrate into all spheres of the individual.

Mr. Infield's book is a study of co-operative communities in various parts of the world. This is another system of organisation for the post-war world; but it is the antithesis of nationalization. The communities are collections of individuals who are willing and able to work together as units to develop agricultural production and to promote higher standards of rural life. The purpose of the survey was to help organise co-operative communities as a vanguard of rural resettlement.

The two fundamental motives for all co-operative settlements have been religion and social reform, and the study covers a selection of communities falling into each group. There is a very illuminating analysis of the Hutterites, the New Llano Colony and the Sunrise Community, which also throws light on those communities in the past which have not survived. Examples of more recent ventures which have been included are the co-operative farms established by the U.S. Farm Security Administration (1937–43), the Mexican Ejido, the Russian Kolkboz and the Palestinian Kvutza.

The survey has been carried out in a masterly manner, and the appraisal of each type of community allows a comparison to be drawn. It discusses their economic policies, their political machinery and the results achieved. One conclusion which is immediately apparent in this study is that the absence of the co-operative spirit in any community brings a threat of failure, no matter whether those communities were founded by individuals or governments.

Mr. Infield is adverse to any rigid plan for post-war resettlement on co-operative lines, owing to the great variation in the physical conditions of each settlement and the character of the population. There is the need for a vital motive to knit the group closely together. Rational motives tend to lead to dissension.

In this context the survey discusses the requirements of membership, the administration and management and the degree of co-operation to be achieved. As a study it is both interesting and instructive; but the simple and easy style of the writer should commend this book even to the ordinary reader.

The third book under notice is a poor attempt to propound a fundamental truth—the need for Christian ideals (brotherly relationship, the author calls it)—in an economy run on business-like lines and activated by the profit motive. Some of the comments are certainly of value, but they are completely lost in the book, which is both badly written and badly printed. The reader would, indeed, have to feel very penitential to take the trouble to go through all 218 pages and winnow the chaff from the wheat.

SCIENCE AND PHILOSOPHY

Science and the Meanings of Truth

Studies Introductory to asking What is meant to-day by Physical Explanation of Nature, by Mechanisms of Cause and Effect, and by a Claim that Scientific Knowledge is True. By Dr. Martin Johnson. Pp. 179. (London: Faber and Faber, Ltd., 1946.) 12*s.* 6*d.* net.

As may be gathered from its sub-title, the central theme of this book is an examination of the meanings which have been or may be given to the word 'truth' in relation to recent developments in physics.

"Until the era of some recent researches in atomics and relativity, the advances of science were satisfactorily carried forward by alternation of simple hypothesis and experimental test; the quantities mentioned in the former were not unlike those measured in the latter, the nature of hypothesis being restricted to a certain kind which had served adequately from the Renaissance. In particular, the success of early modern astronomy, in replacing geometrical description of planetary motion as imaginary combinations of circles, by actual elliptic orbits linked causally with a theory of gravitation, had set a type of hypothesis in which a cause was assigned for activating a mechanical model or mental picture. In later uses of this kind of picture, the criterion of truth to be tested by experiment was whether the supposed and imperceptible substances underlying perceivable phenomena act in accord with the Newtonian laws found adequate for the behaviour of visible and tangible objects. Striking success followed the exploitation of this criterion of truth in the theory of gases and of heat, and the electromagnetic theory of light, and some of the simpler theory of metals."

But with recent researches in physics, this idea of cause in the sense of "forces causing changes in motion" broke down, because it became impossible to construct mechanical models. Such models have, in fact, been recognized as concepts, and scientific knowledge regarded as a system of formal relations instead of a correspondence with any external world imagined in a model.

After reviewing briefly the meanings of truth implied in the writings of Heisenberg, Dirac, Eddington, Milne, Whitehead and Russell, Dr. Johnson puts forward a view of his own. For him science rests on the postulate that Nature is intelligible, and the essential fact underlying this is for him that scientific knowledge is communicable. That is, first, after measurements have been made propositions are formulated in such a way that the results are repeatable and therefore verifiable; secondly, such statements are further judged by 'coherence' in the sense of correlating the widely different physical situations within each of which communicability has already guaranteed a degree of truth. For example, the conic sections which replaced the medieval circles in describing planetary motions could also describe the orbits of comets and were a valuable though transient help in the supposed orbits of electrons within the atom. This criterion of truth is thus a practical one—"coherence between communicable patterns of measurement". We no longer ask whether the 'wave-electron' or the 'particle-electron' are true or false "in the sense of corresponding to any permanent object with the model properties of anyone's mental picture or concept", each theory is simultaneously 'true' as "each is communicable over its own range of physical situations".

The second part of this book is concerned with more general philosophical problems arising out of the meanings given to truth in science and in particular with the relation of the physicist's mind to the experience which comes to him from without. The discussion is confined to the types of problems arising rather than with an attempt to solve them.

This book is not easy to read, and the style is involved and not always happy. It does, however, cover many interesting topics and not its least value is that it is written by a practising physicist thinking his way through the implications of his subject.

A. C. Crombie

A GUIDE TO THE ASTROLABE

Traité de l'astrolabe

Par Henri Michel. (Ouvrage publié avec le concours de la Fondation Universitaire de Belgique.) Pp. viii + 202 + 24 plates. (Paris: Gauthier-Villars, 1947.) 1,200 francs.

There are not a few treatises, old and new, that concern themselves with that ancient and beautiful instrument, the astrolabe; but few, if any, are of use to the student or collector possessing an astrolabe who wishes to know how old it is, how it is used, and what are the principles that underly its construction. The work under review most admirably fulfils these functions, and its account of the multifarious types of astrolabe is the clearest and most reliable of those known to the reviewer.

The book is divided into two parts. The former of these deals briefly with the history of the astrolabe and goes on to a description and explanation of the various types, eastern and western. The author discounts the generally accepted ascription of the invention to Hipparchus, largely on the ground that it was not known to Ptolemy, whose *astrolabon organon* was something quite different from the instrument to which the name of astrolabe has been traditionally attached. He finds the first reference to this, the planispheric astrolabe, in the sixth-century treatise of Philoponus, who tells us that his master Ammonius (*c.* A.D. 500) had written on the subject. M. Michel's view is clearly in accord with

the facts as known to us, though many students of ancient science will feel that an instrument so admirably devised and designed is unlikely to have emanated from the almost extinct fires of Greek culture. Very admirable is the author's clear account, in non-technical language, of the basic principle of the astrolabe, namely, the superposition of a movable map of the celestial sphere upon a map of the terrestrial as viewed from the locality of the observer. His explanation of the stereographic projection on which the instrument depends will be clear even to those whose geometrical equipment is of the slenderest. The book next considers the parts of the astrolabe, and enables the reader to discover the purpose of the networks of circles and arcs which are engraved on every part of these instruments; this is particularly valuable for the understanding of the oriental types. M. Michel devotes more than one section to the practical use of the astrolabe, to which some more pretentious treatises give so little attention that the reader wonders whether their authors considered the instrument as a thing of use or only as a collector's piece: the reviewer, indeed, when first confronted with a collection of astrolabes, was forced to resort to Geoffrey Chaucer's little treatise on the subject, which explains the essentials with admirable clarity.

Astrolabes, to-day, are the prized possessions of museums and connoisseurs, and their owners are greatly interested in a matter which seemed less important to their makers, namely, the date of their construction. In the second part of the book under notice, M. Michel has assembled the methods by which such dates can be estimated. To find a date on the instrument is eminently satisfactory, yet it is not uncommon to find that this has been added and indicates the time at which the instrument was repaired or remodelled. The maker's name may be inscribed, and the book gives a very useful and full list of makers with their dates and brief notices of their work. But the collector's chief problem is the dating of the astrolabe which bears no inscription. Considerations of style and design are useful, and the series of full-page plates of astrolabes, twenty-four in number, at the end of the book is a valuable guide to those who have not been able to see a large collection of these instruments. But the most useful feature is a discussion of the dating of the astrolabe from the astronomical data implied in its markings. Thus many astrolabes are engraved with a zodiacal calendar, and the date of the first point of Aries indicates the number of days by which the Julian calendar differed from the astronomical, and therefore the approximate date. The author makes the valuable point that the difference will depend on which of the four years of the leap-year cycle the instrument was constructed and that an uncertainty of about a century may thus result. Other methods, such as those involving the alteration of the positions of the stars through the precession of the equinoxes, are more reliable, and the application of them should settle many hitherto doubtful cases.

The book concludes with a section on the use of the astrolabe for the elementary teaching of astronomy, in which connexion the late Prof. Jenkin's Oxford astrolabe, designed for such a purpose, might have received a mention.

All who have to do with the astrolabe will be truly grateful to M. Henri Michel for providing them with a valuable and much-needed instrument of research.

F. SHERWOOD TAYLOR

PUBLIC HEALTH TO-DAY

Recent Advances in Public Health

By Dr. J. L. Burn. Pp. viii+409. (London: J. and A. Churchill, Ltd., 1947.) 25*s*.

THIS book is well printed and illustrated, clearly written and, while full of factual data, is easy to read.

In a volume of this size much of necessity is omitted. We should have liked, for example, in Chapter 22 on venereal disease schemes to have had an account to show how modern methods of treatment by the sulphonamides and penicillin have changed the whole outlook on venereal diseases and advanced the prospect of their ultimate eradication. In the preface the author disarms criticism of this kind by pointing out that recent advances in public health have been on so wide a front, so quick in pace, so significant in nature, that he can only restrict himself to the task of summarizing selected features of recent progress, and has had to leave many advances of fundamental importance unnoticed.

Even with this self-imposed limitation, the field covered is very wide. The subject-matter is considered in three main parts: public health and the individual; public health and the community; and public health and the environment.

In the first part, admirable and succinct accounts are given of the Public Health Nursing Service in Britain; the care of mother and child; nursery care; the school health services, with desirable emphasis on the provision of school meals; health education; mental and dental health services; and social services, with special reference to the important work of the almoner. A chapter follows on the handicapped child; and here due weight is assigned to the work of J. Alison Glover, who for some twenty years, in the reports of the Chief Medical Officer of the Ministry of Education and elsewhere, has adduced cogent evidence to show that in the majority of cases tonsillectomy is an unnecessary operation. Yet still one quarter of a million tonsillectomies are said by Maxwell to be performed annually in Great Britain.

The advantage of dealing with the family in the interests of public health is set out, and an informative chapter on welfare of the aged follows. This is a topical problem of increasing importance and magnitude. Dr. Burn shows what can be done here and in other countries to deal with it. In the second part, chapters of special interest are: Chapter 19, diphtheria immunization, which the Ministry of Health with the co-operation of local authorities has done so much to promote for the past twenty years; Chapter 21, tuberculosis, with an able appreciation of the Papworth Colony and an account of mass radiography; Chapter 23, detailing the modern work on scabies; and Chapter 24, which describes the use of D.D.T. in the conquest of typhus fever, etc. The third part dealing with environment is the shortest in the book, but treats of such varied subjects as smokeless air, milk, road safety, cremation and garden cities. The references in each subject, together with suggested books and papers for further reading, are copious and useful.

The Medical Officer of Health of Salford has done good service to the cause he serves by writing this book, which will appeal to all those who wish to keep abreast of a progressive science.

ARTHUR S. MACNALTY

NATURE LOVER AND FISHERMAN

Travelling Naturalist

By Anthony Buxton. Pp. 224 + 31 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1948.) 10*s*. 6*d*. net.

A NEW book by Anthony Buxton is something very special for those who love Nature. He is a shrewd and careful observer, and he writes in charming, simple English prose. In this, his latest book, there is literally not one dull sentence from the beginning to the end. He permits himself a sly dig at naturalists who use long and learned words: he certainly steers clear of them himself.

The book takes us from Norfolk and Essex, Hampshire and Yorkshire, to Scotland, where he fishes the Loch of the Shieling of Angus with skill and profit. We are then taken over the sea on his magic carpet to foreign lands, and with him watch the izzard basking in the autumn sun on the high rocky ridges of the Pyrenees and, still farther afield, watch the snow partridge swing over the snowy slopes of the Caucasus at a height of 10,000 ft. above the sea. With him, we fish rivers in Norway and share his skill in hooking giant sea trout on the lightest of light tackle, and are scarce able to keep pace with him as he flies along the rocky bank of some swift-flowing, green-tinted torrent, or hurls himself, waders and all, into the icy water, to float downstream like one of his flies in order to avoid the arch of a bridge toward which a great sea trout at the end of his line is hurrying him. One of the most attractive things in an attractive book is the author's obvious joy in living. His affection and understanding for the wild creatures which he describes so well are obvious, and he deplores the effects of the prolonged Arctic spell of 1947 on wild life. His home county of Norfolk suffered as severely as any district, and the population of bearded tits has been almost wiped out. He mentions the toll taken of redwings, and this reminds me that for the first time I saw not a single redwing last winter or spring in the Isle of Skye, where numbers are usually to be seen during April on their migration to Iceland.

The story (page 62) of izzard jumping over a man's back recalls the story of a small herd of red deer in the Cuillin of Skye which were descending a steep pass when two climbers came in sight of them. The deer came straight on, and the climbers threw themselves flat on the rock, each member of the herd jumping over them on its headlong downhill rush. Anthony Buxton found that the dotterel was a tame bird, and mentions that he might perhaps have stroked it had he so desired (p. 153). It is true that some dotterel are without fear of human beings. I think the most remarkable experience I ever had was when a dotterel on the nest rose from its eggs, ran over to where I was sitting a few feet away, caught a crane fly on my clothes, then looked at me in a knowing way before hurrying back to the precious eggs. His story (p. 187) of marsh harrier chicks killing and eating their younger brothers and sisters reminds me of the prolonged and bitter attacks made by one golden eaglet on the other in the eyrie, and of another eyrie which I visited where one eaglet lay dead and the other, a particularly truculent bird, although still in the downy stage, attempted to attack the human intruder.

The author (p. 195) writes needed words of protest about the bird photographer who is too much in a hurry with his hide, or who enters his hide without taking a companion with him, in order to see him in and, at the end of his watch, to see him out. Birds with very few exceptions cannot count, and when two people go to a hide and one leaves it the bird does not realize that the other has been left behind. As he says, the interest of the birds should come first, that of the photographer second. I foresee many editions of this book, which is an oasis of sanity in the desert of a mad world.

SETON GORDON

ORGANIC SUBSTANCES USED IN INORGANIC ANALYSIS

Organic Analytical Reagents

By Prof. Frank J. Welcher. Vol. 1. Pp. xv + 442. 44*s*. net. Vol. 2. Pp. xi + 530. 40*s*. net. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1947.)

THESE two volumes form part of a work which when complete should be a most useful compilation. The author's aim has been to collect information from the literature describing the uses of all organic substances in inorganic analysis. The term "analytical reagent" in the title is thus taken to include all incidental uses of organic compounds, if only, for example, as solvents in an extraction, a precipitation or a colour test. On the other hand, the operations listed are, in fact, all for the detection or determination of inorganic atoms and radicals (with the exception of tests for acetates, cyanides and cyanates) and applications to the detection or determination of organic compounds are not considered, although the title gives no indication of this.

Introductory chapters in the first volume give a useful résumé of the theory of valency with special reference to co-ordination and chelate compounds and a discussion of the effect of structure on solubility. The main part of the work is then arranged according to a rational classification of the organic compounds listed, all the various applications being included under each. Laboratory methods for preparing the reagents are given and the analytical procedures are described with sufficient working details. No attempt is made at a critical selection of the methods given, the author's aim being to include everything so that the reader may be free, either to ignore, or to attempt the improvement of, any imperfect methods described. References to the literature are given in every instance, though these cannot always be exhaustive.

From the point of view of the practical analyst using these volumes to find an analytical method for a particular substance an arrangement under analytical headings might have been more convenient. That actually adopted does, however, permit of a general discussion of the uses of any group of substances or widely used reagent, and the practical usefulness of the book must depend on the indexing. Each volume is provided with two indexes, one of organic reagents and one of analytical uses. In the latter, under each analytical problem the various organic compounds are listed alphabetically with references to the body of the work. It may be presumed that collective indexes of all the volumes will be provided when the work is complete.

These volumes are excellently printed and produced, and analysts will find in them a mine of useful information and of references to the literature.

G. M. BENNETT

Země Krásná (The Beautiful Earth)

By J. K. Říha. Pp. 376. (Třebechovice, Czechoslovakia: A. Dedourek, 1948.) 540 crowns.

THE sub-title of this remarkable book states that it is "about Nature, civilisation and planning". The author is not only an architect and an engineer, but he also possesses a deep knowledge of the biological sciences and he has attempted to apply this knowledge in town and country planning. Moreover, Mr. Říha has searched old records to find out whether man had in the past attempted to co-operate with Nature in developing civilization.

It appears that in modern times, or at least in the last hundred and fifty years, the production of plant foodstuffs has increased fourfold in Bohemia. Potatoes and cereals have completely changed mankind's living conditions and made possible the extraordinary progress that is usually attributed to technology, though the author emphasizes the part played by biology in this development. He refers to an area in south Bohemia, north of Třeboň, that was converted from useless marshland to useful productivity as early as the twelfth and thirteenth centuries. Ponds and canals (one thirty-five miles long) were made, and the drained land cultivated and used to rear cattle and horses. In the eighteenth century, English influence led to the laying out of tasteful parks both here and elsewhere in Central Europe. This brings the author to his contention that modern civilization is not antagonistic to Nature and indeed succeeds best when planning is directed towards harmonizing the two. The work of the country architect should take account of climate, soil and biological laws so that a community fits naturally into its surroundings.

Other features of this nicely bound folio book, well printed on art paper, are the many fine photographs by the author and his scientific friends, and the 6,000 word summaries in Russian, French and English.

J. G. F. D.

Faune de France

47: Hyménoptères tenthredoïdes. Par Lucien Berland. (Fédération française des Sociétés de Sciences naturelles: Office central de faunistique.) Pp. 496. (Paris: Paul Lechevalier, 1947.) 1500 francs.

THIS volume, the most recent in the Faune de France series, is well up to the standard of its predecessors. M. Lucien Berland is the author of the volumes on the Vespoidea and has placed hymenopterists further in his debt in having written the present monograph. Under the term Tenthredoïdes he includes not only the sawflies but also all other members of the Symphyta or Phytophaga, as they are variously known. As in other volumes in the series, illustrations are a special feature—whole insects figuring very largely and often accompanied by sketches of structural details, while larvæ are illustrated where necessary. Under each species will be found its chief synonyms, followed by a description of its external characters, the main facts regarding its habits, and its distribution in France and also in other countries. Diagnostic keys to both genera and species are particularly clear and easy to follow. Taking the book as a whole, it will also prove helpful to students of the British members of the Symphyta. At the end there is a tabular synopsis of larval characters in the different families and a list of species wherein parthenogenesis, in one form or another, is known to occur. This is followed by an enumeration of those species known to be injurious to cultivated plants and, finally, a catalogue of host plants and the species feeding upon them. This latter, it may be added, will be found particularly useful by many workers.

Birds on the Wing

By John Barlee. Pp. 128. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1947.) 12*s*. 6*d*. net.

Birds of Malaysia

By Jean Delacour. (Pacific World Series.) Pp. xvi+382. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1947.) 25*s*. net.

The Birds of Brewery Creek

By the Rt. Hon. Malcolm Macdonald. Pp. x+334+23 plates. (London, Toronto and New York: Oxford University Press, 1947.) 21*s*. net.

BIRD books come and continue to come, being for the most part very excellent, and the three here considered are well up to standard. In "Birds on the Wing", we are shown a number of fine snapshots accompanied by excellent notes from the camera and notebook of one of our younger naturalists. "Birds of Malaysia" is of different type, for in it Captain Delacour gives us a handbook to the birds of the interesting islands of Java, Sumatra and Borneo, the Malaya Peninsula, etc., with their wealth of bird life. Here are found such ornithological gems as the giant argus and Bulwer's wattled pheasants, the great hornbills, many sunbirds and so on. This volume with its excellent line drawings is a most helpful guide to them all. The third book, "The Birds of Brewery Creek", is of yet another type, though as good in its different way. In it Mr. Macdonald, High Commissioner for the United Kingdom to Canada, tells of his observations on birds in Brewery Creek, near Ottawa, and a very joyous record it is. The illustrations are from photographs and some of them are in colour, an especially excellent one being that of a snowy owl.

FRANCES PITT

The Annual Register

A Review of Public Events at Home and Abroad for the Year 1947. Edited by Ivison S. Macadam, assisted by Hugh Latimer. Pp. xii+568. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1948.) 42*s*. net.

FOR the first time in its hundred and eighty-nine years of publication, this volume has been compiled with the aid of an advisory board. The selection of the board has been entrusted to five organisations concerned with the subjects covered by the annual review. These are the English Association, the Arts Council of Great Britain, the British Association, the Royal Institute of International Affairs and the Royal Historical Society. These bodies have chosen the contributors. The "Year in Science", running to more than twenty pages, gives a wide and readable survey of the year's work and is an improvement on the articles of previous years. There is little change, however, in the general arrangement. The greater part of the volume is a review of the history of the United Kingdom, the British Commonwealth and foreign countries. Then follows a chronicle of events and reviews of literature, art, science, finance, industry, trade and law. A number of public documents include the Anglo-French Treaty, and those terms of the Yalta, Teheran and Potsdam agreements which remained secret until 1947. The volume is full, comprehensive and impartial and remains, as always, an indispensable survey of human affairs.

THE RONALD ROSS JUBILEE

ANNIVERSARIES and celebrations of medical discoveries have little except historical interest unless they have some direct bearing on present problems. In the case of malaria they have. Fifty years ago, medical men and sanitarians were given a new tool in the form of knowledge of the means of transmission of malaria from man to man. This was heralded as the immediate forerunner of a recession of malaria throughout the world. Forty years experience left these hopes unfulfilled, the new knowledge being applied on a relatively small scale and mainly to highly specialized communities such as towns, labour forces and armies, which are, of course, unrepresentative of the mass of rural tropical peoples. The last ten years work, which is now being brought together and appreciated, shows that there is no longer any reason why the original aim should not be rapidly achieved if the importance, and the limitations, of recent discoveries are fully realized by medical men, administrators, and others concerned in the health of the tropics. A restatement of past history, an emphasis on the lessons to be learnt from it, and a summary of present knowledge based on an appropriate occasion such as the fiftieth anniversary of Ronald Ross's discovery is therefore considerably more than a sentimental occasion. The Ross Institute of Tropical Hygiene, which is amalgamated with the London School of Hygiene and Tropical Medicine, has attempted this survey and assessment in the form of an exhibition open to the public throughout the past week.

Much controversy has surrounded the subject of Ross's discovery, which was finally completed on July 9, 1898. Briefly, the facts are that Laveran[1] first described the parasites of malaria in 1880, his discovery being much elaborated by Italian workers such as Marchiafava and Bignami[2]. In 1894 Patrick Manson, who had previously described a part of the cycle of development of *Wuchereria bancrofti* in a mosquito[3], suggested that this insect might in some way be an intermediary in the carriage of the malaria parasite[4], though he did not foresee the cycle as we know it. Meanwhile Ronald Ross, who had been in India since 1881 and had shown a passion for the preventive aspect of medicine, set out to discover the basic facts of malaria with the object of producing a method for its control. The present speed of dissemination of knowledge makes it difficult to accustom ourselves to the idea that even an earnest and serious worker such as he remained ignorant of Laveran's discovery, and worked on pointless side-issues, until 1894. In that year he met Manson, who demonstrated the parasite to him, set him to its study in the laboratory and in the new translation of Marchiafava and Bignami's book, and fired him with interest in his own mosquito theory. From that time these two men worked as patron and protégé, Ross carrying out all the experimental work to inquire into the theory formulated by Manson, from whom he received constant advice and encouragement.

During 1894–97 Ross worked mainly in Secunderabad, Hyderabad, on human cases of infection with *Plasmodium falciparum* and several species of mosquitoes. On August 20, 1897, he demonstrated the development of gametocytes of *P. falciparum* up to the stage of four-day-old oocysts in the gut wall of a 'dapple-winged mosquito', almost certainly *Anopheles stephensi*. This was recognized as complete proof that development of the parasite did occur in the mosquito, thereby incriminating that insect as a carrier and establishing Manson's theory, and was published in December of that year[5]. It stopped short at showing that man infected the mosquito without showing how the mosquito infected man, and again it is difficult for us to realize that this was by no means obvious.

At this stage, Ross's work was interrupted by his transfer to a remote non-malarious station. In February 1898 he was able to resume it in Calcutta, but without human material. He turned to avian material and *Culex* mosquitoes, and between February and July 1898 showed successively the ripening of the oocyst, the liberation of sporozoites into the body cavity, their invasion of the salivary glands, and the transmission of infection from an infected bird, through *Culex fatigans* to previously uninfected birds. Some parts of the story were published while the work was in progress, and the full one was communicated by Manson to a meeting of the British Medical Association on July 28, 1898, published by him shortly after[6,7,8], and after a further interval by Ross[9].

During the following six months, some Italian workers, Bastianelli, Bignami and Grassi[10], repeated Ross's observations using *P. falciparum* infections of *A. maculipennis*, and as the result of faults on one side or another an unnecessary and bitter controversy on priority ensued.

Ross left India where his discovery had been coldly received, joined the new Liverpool School of Tropical Medicine, immediately went to Sierra Leone and there in 1899 himself confirmed the full cycle of *P. falciparum* in *A. gambiæ* and *A. funestus*[11]. Manson, as the first item of work of the new London School of Tropical Medicine, confirmed the story by the celebrated Ostia experiment[12]. He and his fellow-workers lived safely in mosquito-proofed huts in the malarious Roman Campagna and brought back to England mosquitoes which infected volunteers who had never left the country.

The value of the discovery and the status of Ross were finally established by the evidence of Lord Lister[13]. Its practical value was soon demonstrated by pioneer work in Malaya[14], Ismailia[15] and Havana; but the record of its application up to 1939 was disappointing. Techniques were elaborated, mosquito larvicides such as Paris green were discovered, the possibility and value of adult mosquito destruction proved[16,17], new drugs such as 'Atebrin' produced[18] and much new knowledge of the epidemiology and entomology of malaria gained; but all this had little effect on the subject which interested Ross, namely, the prevention of malaria throughout the whole tropics including rural areas.

The period 1939–46 has seen the acquisition of much new knowledge, notably of insecticides, techniques of organisation, drugs and a further elaboration of the history of the malaria parasite[19]. For the first time this was brought together at the recent International Congresses on Malaria and Tropical Medicine in Washington, the proceedings of which are not yet in print, and considered by the Malaria Committee of the World Health Organisation[20]. The major interest of these meetings lay in the revelation that malaria control throughout whole countries, urban and rural areas alike, is not only possible but also has

actually been put into practice. In Venezuela, British Guiana, Chile, the United States, Sardinia, Italy, Greece and Cyprus, malaria has either practically or entirely ended, as it has also in a rural area of Bombay Province holding some two million people, and in the extensive Kharga and Dhakla oases of Egypt. There have been marked reductions in other places, including the Union of South Africa, and invading foreign mosquitoes have been evicted from Brazil[21] and Egypt.

Two entirely separate principles have been concerned in this. The first is the total eradication of anopheline species (or anopheline genus in Cyprus), made possible by organisational techniques not dependent on new insecticides and ensuring perfection of local work; this has so far been used in areas with some natural protection against re-invasion in Brazil, Egypt, Cyprus and Sardinia. The other is the country-wide application of D.D.T. residual indoor sprays to all houses and anopheline shelters, producing control of anophelines at a level below that necessary for malaria transmission but not of the perfection needed for eradication; it is this process which is largely responsible for the recession of malaria in the United States, Venezuela, British Guiana, Chile, Italy, Greece, the Union of South Africa, and parts of Bombay Province.

The exponents of the two methods are in friendly rivalry; their methods too young as yet for accurate comparison, but both are practicable on a large scale. The tropical and subtropical world stand divided into two sections, one of which has, and one of which has not, attempted to apply either of these principles. It is regrettable to find tropical Africa in the latter group, though as yet unresolved doubt has been thrown on the value of D.D.T. in that country[22]. The Malaria Committee of the World Health Organisation has, however, agreed to support a large eradication scheme in the heart of that continent, and if D.D.T. should be valueless there 'Gammexane' (the gamma isomer of benzene hexachloride) could almost certainly take its place.

The story of these stages and of present trends was told in the Ross Institute Exhibition. If it succeeds in stimulating the British application of these new methods, the Jubilee will have been of real value.

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THE POST OFFICE RESEARCH STATION

THE earliest experimental work in connexion with the telephone and telegraph services of the General Post Office is recorded to have taken place in 1878. It was, however, not until 1904 that one or two members of the Engineering Department were relieved of their administrative duties to enable them to pursue investigations of a purely experimental nature in a room set aside for the purpose in the Central Telegraph Office. In 1909, the 'Research Section' was recognized as a separate entity, and additional laboratories in a nearby building were allotted to it. Natural expansion of the section, curbed during the First World War, was accelerated when hostilities ceased, and a site of eight acres was acquired for a research station at Dollis Hill in north-west London and about seven miles distant from the Central Telegraph Office. The work was transferred to this site in 1921, when the accommodation took the form of ex-army huts; the present permanent buildings were formally opened in 1933. The activities of the Research Station expanded steadily during the inter-war period, and during the Second World War they were diverted to deal almost entirely with objectives having immediate military application. Arrears of normal development of research for the Post Office's services now require an accelerated expansion, which is being effected as rapidly as present circumstances permit.

There are at present about twenty buildings at the Research Station, used as laboratories, workshops and offices by the Research and the Radio Development Branches of the Engineering Department of the Post Office. The present staff totals about 860, of whom about 470 are directly engaged on experimental or theoretical work (including some 275 who are engineers or scientific workers with full professional qualifications or have nearly attained them). About two hundred are employed in the workshops and drawing office. The experimental work of the Department is not confined to the Research Station; there are small laboratories in other parts of the country, and some experimental work has to be done in the field.

The activities of this Research Station are mainly directed towards improved and economical working of Post Office services, especially the telecommunication services, because for these there is wide scope and need for the application of the development of physical science. Apart from some radio equipment, almost all the necessary plant for these services is obtained by purchase from manufacturing companies. For the development and introduction of new types of apparatus into service, the Post Office maintains close liaison with the principal British manufacturers of telecommunication equipment, and a regular procedure exists for exchanging information concerning, and co-ordinating the development of, much of the equipment that is procured. There is also liaison and, when necessary, co-ordination with other Government research establishments and, on the international plane, with other telecommunication administrations. Broadly speaking, therefore, the main function of the Research Station at Dollis Hill is to contribute to advances in telegraphy, telephony and radio and to give guidance on their applications to Post Office services. Some of the investigations, important though limited in scope,

arise from the day-to-day operation of the services and are concerned with existing plant; others are of a long-term character and represent, perhaps, seeds of the telecommunication plant of the future.

Many of the developments (to which the Research Station has contributed) produce results which are by no means immediately obvious to the users of the telecommunication services. The continued, and sometimes rapid, growth of the telephone network in Great Britain could not have been achieved, or only at much greater expense, without entirely new techniques in telephone transmission, such as the use of one pair of conductors to provide speech channels for many simultaneous conversations. Economies resulting from the introduction of more efficient types of equipment cannot be made to give immediate benefit to the users, in terms of lower charges, because, for the very large and dispersed plant which comprises the telephone network, any large-scale replacements must necessarily be spread over a very long period. When costs of labour and materials are tending to rise, the effect of such economies is more likely to appear as a lower increase in the charges for the service than would otherwise be necessary. On the other hand, some developments, for example, those which open up new services or facilities for the user, are more obvious; a case in point is the 'speaking clock'. This was the result more than eleven years ago of research into an electric drive starting from a 'free' pendulum and other research on sound-recording on glass disks.

Modern technique for telephone transmission over long land-line routes is to concentrate a number of telephone conversations on to a single pair of conductors, the conversations being separated on the route by occupying different bands of the frequency spectrum. Thus, the traffic capacity of a route is determined by the total band-width of frequencies it can carry rather than by the number of conductors it contains. With wide-band amplifiers (or 'repeaters') spaced at intervals of about six miles on a modern coaxial (or concentric) type of cable, two coaxial tubes can carry more than six hundred separate conversations simultaneously. This technique of wide-band transmission is being still further developed for the transmission of television to programme centres at different parts of Britain. Short lengths of wires in ordinary telephone cabling can be 'equalized' for carrying television signals locally, but for long-distance line transmission of television, the newer types of cable are essential.

By means of frequency separation, several telegraph transmissions can be sent simultaneously over a single telephone circuit independently of whether the telephone circuit is on a radio link, a coaxial cable, or by normal transmission over a pair of wires.

The Post Office Research Station has played a leading part in the development of semi-automatic means of switching long-distance telephone circuits. These enable the trunk operator at the calling end to actuate switches by dialling over the long-distance line and avoid the delay which arises when she is dependent on the assistance of other operators at the remote exchanges. The methods of dialling which are used in local areas could not be extended to the long-distance lines, and a system had to be worked out in which all the signals could be transmitted by currents in the speech frequency range without mutual interference between speech and signals. This system is now working on more than three thousand British long-distance circuits.

For telephoning overseas, either submarine cable (for the shorter distances) or radio links have to be used. In the case of the cable, a substantial advance has been made towards increasing the band-width of frequencies (and hence the number of simultaneous conversations) transmitted by inserting a submerged repeater. The repeater has to be capable of continuous operation under water without any maintenance for several years, with power for its valves supplied along the cable. The repeater which the Research Station constructed in 1943 for the Holyhead – Isle of Man cable was the first submerged repeater to be inserted in a working telephone cable anywhere in the world. The scheme is being developed to enable several repeaters to operate along a submarine cable, with facilities for testing and supplying power to each one from the shore ends.

Long-distance, short-wave radio links have been greatly improved since their inception by the use of single-sideband radio transmitters and receivers. On the trans-Atlantic link, reception from the United States has been made much better by the employment of special receivers and an aerial system, two miles long, installed at the radio station at Cooling (Kent). This equipment separates the mutually interfering waves by which the signals arrive after successive reflexions from ionized layers in the upper atmosphere, and so reduces the effects of distortion and noise. The study of other means for dealing with these effects has been facilitated by a laboratory device for simulating them under controllable conditions. Since 1934, radio links on much shorter wave-lengths have been used for extending the telephone network to islands around the coast of Britain; equipment operating on the frequency-modulation system was first installed on one of these links in 1942.

The Post Office not only operates radio telephone and telegraph services to all parts of the world, including ships at sea; it is also the Department responsible for control and regulation of radio communication. This responsibility involves the need for very exact measurements of any frequency which may be used. The applications of piezo-electric quartz crystal vibrators has been studied since 1925 for frequency control of radio transmitters and for frequency measurement, and the Research Station possesses one of the most comprehensive frequency standard installations in the world. It has provided quartz clocks, the most accurate timekeepers now known, to the Royal Observatory, Greenwich. Other piezo-electric materials are being studied for various applications, notably as components in the electrical circuits used for frequency selection and separation.

Telephone instruments are electro-acoustic devices, so there is need for acoustical as well as electrical measurements; the techniques for acoustical measurement have been developed much more recently than their electrical counterparts. The Research Station has contributed to these developments and it maintains a standard and equipment for the measurement of sound pressures at any desired point, in the open or in a confined space, so that objective measurements of the performance of telephone instruments of any type can be made in conditions appropriate to their use. It also has to set and maintain a standard of 'telephone transmission', which is based on subjective tests and is therefore of a less tangible nature, combining physics with physiology. Recording of sound is studied for special applications by the Post Office; two techniques have received particular attention, namely, sound tracks on glass

disks for frequent repetitions of short announcements, and lacquer-coated metal disks for high-quality gramophone recording, usable (for short life) by direct play-back.

New developments and applications of electronic devices are of vital importance to telecommunications. Facilities for the manufacture of experimental types of thermionic valves enable, for example, knowledge to be built up concerning the causes of their eventual failure and may be helpful towards the provision of the very long-life valves required for submerged repeaters. Such facilities also open the way for development of a few special valves for special uses. Techniques of application, such as are used in electronic computers, are studied; in fact, an elementary form of electronic computer has been made for dealing with some specific problems of plant provision and arrangement at automatic exchanges.

The main exception to the concentration of effort at the Research Station on telecommunication problems is the work that is being done to explore the practicability of introducing more mechanical processes in the handling of mail. Machines incorporating photo-electric devices can be devised to work at high speed for stacking letters, all with the stamps in correct position to be fed into stamp-cancelling machines, and also for enabling sorters to direct letters into a much larger number of sorting compartments than can be reached by hand. Considerable experimental and development work is necessary before any machines of this kind can be proved to be practicable.

LAND AND POVERTY IN THE MIDDLE EAST

DURING the Second World War, the Middle East Supply Centre—the history and achievements of which should be made public before memory fades—acted in various directions as a regional authority over an area embracing about fourteen territories, and extending from Persia to Tripolitania, and from Cyprus to Ethiopia. One of its important short-term objectives was to encourage increased food-production in the Middle East territories, to offset the unavoidable restrictions due to war conditions. This immediate objective threw into sharp relief the need for a comprehensive regional survey of the basic underlying problems of the Middle East—in particular, land utilization, peasant economy and social organisation—and this task, among others, was given to an Anglo-American Scientific Advisory Mission, the reports of which have now been published by the Stationery Office*. War conditions threw the Middle East territories into close association, and emphasized the fact that they had many common basic obstacles to overcome before any post-war social and economic development was possible.

There were high hopes that some form of regional organisation would succeed the Middle East Supply Centre, to serve these non-political aims. But political inexperience and short-sighted nationalism were too strong. Chatham House has, not for the first time, attempted to fill the gap by publishing a series of studies on social and economic problems in the Middle East. The pamphlet* under review is the first of the series; it deals with Egypt and the Fertile Crescent—Palestine, Transjordan, Syria, Lebanon and Iraq. Dr. Warriner describes the vicious circle enclosing the peasant cultivator in these regions; but the description is equally true for other Middle East countries, and for India. It is essentially an absentee landlord system, with a form of land tenure under which the tenant suffers the maximum disadvantages. Government of the country is largely in the hands of the landlords, most of whom believe their immediate interests would be threatened by any measures designed to improve the tenants' lot. The tenant is wrapped in a fatalism, which is founded on his poverty and helplessness, and reinforced by the technical difficulties of agriculture—especially of peasant farming—in tropical and sub-tropical climates and soils. The social and environmental circumstances that brought about in England the change from the open three-field system to the four-course rotation on enclosed farms do not exist in the Middle East.

Dr. Warriner examines in detail the alternative possibilities. Although most of the suitable land and a good deal of the marginal areas are already settled to capacity or beyond, there are under-populated spaces in the Jezira region of Syria; in Iraq, with better regulation of water supplies, there could be absorbed some five million people, and she points out, as one item in the immensities of the Middle East problem, that this is an authoritative figure for the surplus rural population in Egypt alone.

On the question of quick technical improvements in agricultural methods, Dr. Warriner rightly concludes that these are strictly limited, first, by our present lack of knowledge of tropical agricultural science (a point that cannot be overstressed), and secondly, by the limitations of the existing system of peasant agriculture. Further, such improvements could only be short-range palliatives, for, in the present stage of social emergence of the peasant, any increase in output per acre is more than offset by an increase in the population. At present there appear to be two possibilities only for increasing the output: the development of irrigation under State ownership and control; and, in the drier areas, mechanized dry farming on a village co-operative basis. Both involve a basic change in land tenure customs, and the second especially calls for less, not more, workers per acre.

Dr. Warriner discusses my first proposal for a tripartite organisation that would circumvent the grave obstacles of land ownership and inheritance laws. The proposal is as follows. The Government takes over, on a long lease, land from its present owners, and sub-leases the whole area to a body of the public utility corporation type. This body reconditions the land, divides it into economic units and lets them to tenant farmers for whom it performs certain desirable services—such as bulk-marketing of any cash crops—and from whom it requires certain standards of farming as a condition of the lease. In concluding that this model would not be generally applicable, because it depends on the existence of a special market for which the corporation can finance sales and organise production in relation to the market, Dr. Warriner has rather missed the point of the proposal. It is true that in

* The Agricultural Development of the Middle East. By Dr. B. A. Keen. 5s. net.
Middle East Science. By Dr. E. B. Worthington. 7s. 6d. net.
Rural Education and Welfare in the Middle East. By H. B. Allen.
Animal Industry in the Middle East. By Dr. N. C. Wright (in preparation).
(London: H.M. Stationery Office, 1946.)

* Land and Poverty in the Middle East. By Doreen Warriner. (Middle East Economic and Social Studies.) Pp. vii+149. (London and New York: Royal Institute of International Affairs, 1948.) 7s. 6d. net.

certain of the examples given by me this aspect is prominent and that it even initiated some of them. But it is not the essential requirement, which is, of course, the circumventing of the land ownership laws: without some such device, an agrarian revolution, expropriation and the rest, are sooner or later inevitable. There is no reason why the proposal should not apply to subsistence crop production; the general financial level would be lower and the operations of the corporation more modest, approximating to what would be done by a co-operative buying and selling society, composed of the tenants themselves. Organisations of this type were working well among the Bulgarian peasant proprietors before the War, and their success was not dependent on the fact that the peasant owned his farm.

At the same time it is clear that lack of capital in the Middle East is an obstacle to rapid development, for it also causes peasant indebtedness to the landlord-moneylender class. Dr. Warriner examines two sources of supply: the war-time sterling credit balances and oil royalties. Both are wasting assets, and both are likely in the present conditions to enrich the few. A speculative possibility briefly mentioned by Dr. Warriner is to form, perhaps under the United Nations, an international agency to promote investment and long-term economic development. This is, in fact, the public utility corporation referred to above, on a somewhat more ambitious scale.

The pamphlet sets a high standard for the succeeding ones. It is lucidly written and the author's personal knowledge of the area has enabled her to set out the essentials of a very complicated situation.

B. A. KEEN

THE MEDICAL NOBEL INSTITUTES, STOCKHOLM

THE Caroline Institute in Stockholm, in all but name the medical university of the Swedish capital, appointed a committee in 1945 for the planning and building of new laboratories for the three departments of the Medical Nobel Institute. The Department of Biochemistry was founded in 1937 under the direction of Prof. Hugo Theorell; in 1940, Prof. Ragnar Granit was appointed to a research chair in neurophysiology, established with the aid of a gift from the Wallenberg Foundation in Stockholm, and also supported by the Rockefeller Foundation; this became a Nobel Institute in 1945. At the same time, a third department of the Nobel Institute was created, in cell research, under the direction of Prof. Torbjörn Caspersson.

During the academic year 1947–48, the three departments have been moving into their new and spacious buildings in the 'medical city' which is being created by the Caroline Institute in north-west Stockholm on an old estate known as Norrbacka. The administrative centre, the library and some of the laboratories have already moved out to the new site. The Departments of Physiology and Pharmacology are expected to move out in the autumn.

The Medical Nobel Institute was formally opened in May by the Crown Prince of Sweden and dedicated to the Nobel Foundation by Prof. Bergstrand, president of the Caroline Institute. In addition to Swedish representatives from universities and academies, Scandinavian, British and American guests were present. Great Britain was represented by Prof. E. D. Adrian, foreign secretary of the Royal Society. A dinner presided over by Dr. Ekeberg, president of the Nobel Foundation, concluded the ceremony.

In his speech, Prof. Bergstrand, president of the Caroline Institute, emphasized that the Caroline Institute needed full-time research laboratories engaged in work along the front lines of modern science, for its own sake as well as to enable it to fulfil the important task entrusted to it by the will of Alfred Nobel. The beautiful and well-equipped new laboratories, he went on to say, expressed the confidence of the Caroline Institute in the three directors appointed to lead them. Financially, the three laboratories were a joint effort: the buildings and part of the equipment came from the Nobel Fund, which also supported one of the chairs and part of its running expenses; the Government of Sweden supported the other two chairs and contributed to their annual budget; the Wallenberg and Rockefeller Foundations contributed generously to most items of the budget. Prof. Bergstrand concluded his speech by expressing the gratitude of the Caroline Institute to the donors, and, finally, extended a hearty welcome to the guests. Congratulatory addresses were presented by Prof. E. D. Adrian, Prof. W. D. Bronk, foreign secretary of the U.S. National Academy of Sciences, Prof. Linderström-Lang, director of the Carlsberg Institute, Copenhagen, Prof. A. I. Virtanen, director of the Valio Research Laboratory in Biochemistry, Helsinki, and Prof. Mohr, rector of the University of Oslo.

COLOUR TERMINOLOGY

THE Committee on Colour Terminology appointed in 1941 by the Colour Group of the Physical Society had originally two objectives: (*a*) to record definitions of terms current in the various groups of people concerned with colour; and (*b*) to examine the possibility of co-ordinating the terms commonly used. Later, in the light of the Committee's discussions, a third objective was added: (*c*) to recommend a consistent terminology. This was a significant step, as the subject of colour has very wide ramifications and there was every reason to expect very great difficulty in even approaching consistency. The report now published* shows that, provided a few key changes are made, the terms used by different technical groups can be embodied in a single scheme which avoids gross ambiguities while keeping the specialized terms of particular interests substantially intact. The nomenclature of colours themselves, as distinct from the terms used in describing and specifying them, was expressly excluded from the Committee's consideration.

In drawing up the basic list of current terms with their definitions or mode of use—a list which occupies about two-thirds of the 56 pages of the report—the Committee's net was thrown very wide. The fields covered were colour physics (general, photometric, subjective and colorimetric terms), colour vision, colour-atlas systems (Munsell and Ostwald), technologies involving colour (dyeing, paint and pigment,

* Physical Society. Report on Colour Terminology. By a Committee of the Colour Group. Pp. iv + 56. (London: Physical Society, 1948.) 7s. net.

printing, photographic, glass and decorating industries), the painting art and the colour terms of everyday speech. The definitions are fully descriptive, and sufficient explanation of the underlying principles is given to make clear how certain expressions have come into use. In colour physics, once the distinction has been established between subjective terms describing the sensations produced and the corresponding objective terms specifying the stimulus, the definitions themselves present no serious difficulty. The case is different with technological terms. For example, in the paint and pigment industry, the term 'chalky' has a meaning which in the Committee's definition runs "An excess of white (in a match supposed to be close)". But, as is pointed out, in practice, 'chalky' frequently implies that by the addition of wrong pigments or otherwise, a pigment mixture has been made whiter than the sample and that the difference is irremediable.

The colour terms used by contemporary artists are handled very gingerly by the Committee—the proper course for an exclusively technical body—and for these and for the terms of ordinary speech no recommended usage is put forward.

The interrelations of the terms of different groups are displayed in tabular form, and in the case of the dyeing and paint and pigment industries, the different meanings of comparative terms such as 'stronger', 'dirtier', 'brighter', etc., are indicated by vector lines in colour triangles of the Ostwald type with black, white and a particular colour at the vertices.

As a first step to co-ordination the Committee drew up a self-consistent list of essential terms that could be used by all colour workers without risk of confusion. The final recommendations are based on this self-consistent list and cover nearly a hundred terms. The main changes required of different groups are as follows. In colour physics, the term 'brightness' is to be replaced by 'luminosity' when the subjective aspect is in question, and by 'luminance' when brightness as an objective or stimulus quantity is intended. The term 'shade', which at present has several different meanings in the dyeing, paint and pigment and printing industries, is to denote "darker colour of same hue and saturation". The same groups are asked to reserve 'tone' for "any small variation from another colour". 'Duller' (paint and pigment industry) is not to be used to mean "containing more black" but as "less colourful" or "less saturated", while 'deeper' is to mean "containing less white".

In a concluding section the recommended terms are compared with those proposed in the recent Colorimetry Report of the Optical Society of America. Among the comparatively few points of disagreement may be noted the American retention of the term 'brightness' for the subjective meaning of the word, while the corresponding term recommended by the British committee—'luminosity'—is used in the American report for the "ratio of the luminous flux to radiant energy flux". The latter quantity is called 'visual sensitivity' in the British scheme. It is probable that the terms 'luminosity' and 'visual sensitivity' will prove the most controversial in the Committee's recommended list.

Discussions on terminology often appear to non-participants as rather unproductive. But whether or not the changes recommended in this report are adopted, there can be no question that the careful exposition of present usage which it contains will be of the greatest value to workers on colour problems.

W. S. Stiles

NEWS and VIEWS

Geology at the University of Liverpool: Dr. R. M. Shackleton

Dr. Robert Millner Shackleton, who has been appointed to the George Herdman chair of geology at Liverpool, vacant by the resignation of Prof. F. Coles Phillips, returns to the University from which he graduated in 1930 and at which he was awarded the degree of Ph.D. in 1933 for researches into the complex structure of Moel Hebog, Caernarvonshire. On leaving Liverpool, Dr. Shackleton went to the Imperial College of Science and Technology, London, with a Beit Fellowship, and joined the staff of the Geology Department of the College in 1934, becoming senior lecturer in charge of petrology in 1946.

Dr. Shackleton's field-experience has been extraordinarily extensive and varied. He has travelled widely in South and Central Africa and in Russia and Siberia. In 1935–36 he made a reconnaissance survey of Viti Levu in the Fijis, where he discovered that the plutonic rocks, previously thought to be an old basement, are of Tertiary age. During 1940–45, he served on the Geological Survey of Kenya, his chief work dealing with economic problems connected with the Migori gold-belt, the phosphate possibilities of North Kavirondo and the water supply of the Aberdare Range and Mount Kenya areas. In 1946 he returned to Kenya and made a one-man expedition to the Rift Valley, where the sequence of the artefact-bearing beds of the Pleistocene was determined and the structure of a section of the Rift Valley elucidated. Last year he took part in the Royal Society Expedition to Rusinga Island in Lake Victoria, Kenya, from which important results concerning the succession and structure of the Miocene beds in which hominoid remains occur are expected. It is to be hoped that Dr. Shackleton will find time to prepare for publication a part at least of these important results of his field-studies.

Dr. Shackleton has been a member—and largely director—of a research team from the Geology Department, Imperial College, that has been working for a number of years on a project to compare the two sides of the North Atlantic and to test the continental drift theory and in particular to determine the magnitude of any drift that may have occurred. As soon as the grasp of the structure and stratigraphy on the eastern side of the Atlantic is sufficiently firm, it is intended to proceed to the examination of Eastern Newfoundland and the coast of Labrador. His new sphere at Liverpool will provide Dr. Shackleton with increased opportunities for the continuation and completion of this attractive study.

Physiology at the Queen's University, Belfast: Dr. A. D. M. Greenfield

The Queen's University of Belfast announces the appointment of Dr. A. D. M. Greenfield to the Dunville chair of physiology in succession to Prof. H. Barcroft, now at St. Thomas's Hospital Medical

School (see *Nature*, **160**, 704; 1947). Dr. Greenfield was a scholar of St. Mary's Hospital, and obtained first class honours in physiology in the B.Sc. examination of the University of London. After holding posts at St. Mary's in both medicine and pathology, he was appointed to the Department of Physiology, under the direction of Prof. A. St. G. Huggett. A year ago he became senior lecturer in experimental physiology. Dr. Greenfield at first worked with Dr. Killick (now Professor) on acclimatization to chronic carbon monoxide poisoning. More recently, he has shown great ingenuity in devising methods for the study of the circulation both in man and animals. During the War, these were used on behalf of the R.A.F. to study the effect of variations of g on the blood pressure. Since then Greenfield has worked with Huggett on fœtal physiology and found a method for determining the rate of the blood flow in the umbilical cord. At a recent meeting of the Physiological Society he showed how the movements of a large bubble could be photographed and used to indicate the rate of the blood flow in a part of the body, as, for example, the hand. Dr. Greenfield's special knowledge of the physiology of the circulation will be of great value in Belfast, where work in this field has been in progress for some years.

Anatomy at the University of Glasgow: Prof. G. M'C. Wyburn

George M'Creath Wyburn has been appointed regius professor of anatomy in the University of Glasgow in succession to Prof. W. J. Hamilton, who has been appointed to the chair of anatomy at Charing Cross Hospital Medical School, London. Dr. Wyburn is a pupil of the late T. H. Bryce, and graduated at Glasgow in 1925: after holding appointments in various hospitals, he returned to Glasgow as demonstrator in 1929. He became senior lecturer in anatomy in 1936, and was acting head of the Department during 1944–45. His researches include work on embryology, with special reference to bone formation, on the endocrinological aspects of reproduction, and on tissue-grafting (of skin, cartilage and cornea in particular). He was awarded the Struthers Gold Medal and Prize in 1939 for embryological research, and again in 1947 (with Dr. Paul Bacsich) for work done during the War on the repair of peripheral nerve injuries.

Mathematics at Queen Mary College, London: Dr. G. C. McVittie, O.B.E.

The appointment of Dr. G. C. McVittie to the new chair of mathematics at Queen Mary College, University of London, is of considerable interest, not only because he will be the first professor of mathematics at this College, but also because his appointment will go a long way towards strengthening the present somewhat meagre representation of applied mathematicians among the appointed teachers of the University. In pre-war days, Dr. McVittie was well known for his researches into relativistic theories and in particular for his trenchant criticisms of some aspects of certain forms of the cosmological theory. During the Second World War, Dr. McVittie was seconded for special service with the Meteorological Office. Here he was engaged in a number of important problems. As a result of his successful activities both as a man of science and as an administrator he was recently awarded the O.B.E. Since his return to academic life, Dr. McVittie has developed a new interest in the theoretical basis of meteorology and has been made a member of the Meteorological Research Committee. He has also become, with Prof. Ferraro, one of the editors of the new *Quarterly Journal of Applied Mathematics and Mechanics*, the first number of which has recently appeared, and which seems destined to have an important influence on the future development of applied mathematics in Great Britain. Dr. McVittie has also been very actively interested for many years in problems of theoretical astronomy and has been one of the editors of *The Observatory*.

Mathematical Statistics at the University of São Paulo: Mr. W. L. Stevens

Mr. W. L. Stevens has been appointed professor of mathematical statistics in the University of São Paulo, Brazil. Mr. Stevens worked under Prof. R. A. Fisher, at the Galton Laboratory, University College, London, during 1935–41. He then joined the staff of the Statistical Department, Rothamsted Experimental Station, for a few months on urgent war work prior to leaving for Portugal to take up a lectureship in statistics at Coimbra at the request of the British Council and the Foreign Office. In 1944 he returned to Britain and took a post as statistician with Imperial Chemical Industries, Ltd., Billingham. In 1947 he joined the staff of the Admiralty Statistical Department under Mr. H. L. Seal. He has been chiefly concerned with the development of statistical methods in the fields of biological and agricultural experimentation, and has also made contributions to the methods applicable to quality control of industrial products.

New Atomic Pile at Harwell

Rather less than a year has passed since the Atomic Energy Research Establishment at Harwell put into operation 'Gleep', the first atomic pile to be built in Great Britain. Now a second and more powerful pile has been completed and put into operation. Its rated output is 6,000 kW., and it has been designed primarily as an experimental tool, to provide as many facilities as possible without unduly complicating the engineering of the structure. In addition, when operating at rated output, the pile should be able to produce, by transmutation of inactive elements, all the artificial radioactive isotopes required in Britain by medical and other research workers. Like 'Gleep', the new pile is a graphite-moderated air-cooled pile. The uranium rods are enclosed in aluminium cases which lie in channels in the graphite. Cooling air is drawn through the channels by several large electrically driven exhausters. The whole pile is surrounded by a concrete shield several feet thick, to protect workers from radiations, and the cooling air is discharged up a chimney stack 200 ft. high. There are about forty holes in the shield, giving access to the strong fluxes of neutrons in the interior of the pile. These neutron fluxes, many times more intense than can be obtained in any other way, are required for many experiments in nuclear science, both in fundamental and in applied research. Thus, for example, the applied research programme will include an investigation of the effect of irradiation by neutrons on the properties of materials, to provide information about materials used in the construction of piles. The experimental holes are also the means by which inactive elements are placed in the pile for transmutation into radioactive isotopes. Surrounding the pile structure are the control rooms and laboratories used by the

scientific and operating staff. The operation of the pile is controlled by two sets of neutron-absorbing rods; the first set of rods is adjusted to keep the pile operating at a constant-power level, and the second set is available to shut the pile down in any emergency. The basic calculations for the Harwell pile were begun in 1945 by a team working under Sir John Cockcroft in the laboratories of the National Research Council of Canada, and were continued when the team moved to the newly formed Atomic Energy Research Establishment at Harwell. It was the first task of the Department of Atomic Energy at Risley, under the direction of Mr. C. Hinton, to undertake the design of the pile, based on the information provided by the Harwell team. This work began in April 1946. The actual construction of the pile was made the responsibility of the Ministry of Works, assisted by their contractors, Messrs. Chivers.

Earthquakes in Japan

At about 8 p.m. local time on June 28, four severe earthquakes affected the sea and land areas around the town of Fukui, on the west coast of Honshu Island, Japan. The epicentres of the shocks appear to have been near lat. 36·1° N., long. 136° E., though news from the Japanese observatories has not yet been received. An area within a radius of about 30 miles from Fukui was destructively affected. The population of Fukui (about 85,000) was largely engaged in the textile industry (mostly silk), as more than one quarter of the looms of Japan were in the town. There were some ferro-concrete buildings in the town, but most of the buildings were made of wood and these were soon set alight by the fires scattered by the shocks. The fires were difficult to check owing to earthquake damage to the water supply, and it is estimated that nearly 40,000 buildings were damaged beyond repair. A cinema collapsed, burying alive a large number of people, and many casualties were caused by falling debris at the railway station. Six other towns and thirty-nine villages in the neighbourhood were severely affected, including Marouka, Mikuni, Matsuoka, Daishoji and Kanaza. Communications were severely affected and an important railway bridge was destroyed, making relief work difficult. Huge waves lashed the coast. Altogether, some 3,200 people are believed to have lost their lives, and there are thousands of others injured. Aftershocks continued for some days.

In the whole of the densely peopled islands of Japan, there are about five hundred earthquake shocks of varying intensity every year, and although probably the greatest of the world's earthquakes have not happened there, yet there have been tremendous Japanese disasters from time to time. Examples include the Mino-Owari earthquake just after 6 a.m. local time on October 28, 1891, and the shock which almost destroyed Tokyo and Yokohama on September 1, 1923. The present shock is estimated to have been about three quarters of the strength of the latter. Between the smaller shocks of July 16–17, 1941, in the Nagano Prefecture and the shock of May 9, 1947, in Hida, there has been little news, and for part of the time some of the Japanese observatories closed down. Mr. Ernest Tillotson states that news of this period is, however, beginning to arrive: thus between December 18, 1943, and December 1945, to the accompaniment of hundreds of seismic disturbances, a 1,200-ft. high mountain called the 'New Showa Mountain' arose with volcanic eruptions on the fringe of Lake Toya, Hokkaido, similar to the Paricutin Mountain in Mexico. Further news of these tremendous earth movements is awaited.

Scientific Advisory Council to the Minister of Fuel and Power

The Minister of Fuel and Power has appointed the following to be members of the Scientific Advisory Council which will advise him on the scientific aspect of his statutory duties: Sir Alfred Egerton (chairman), Eng. Vice-Admiral Sir Harold Brown, Dr. H. Roxbee Cox, Sir Charles Ellis, Prof. F. H. Garner, Sir Charles Goodeve, Dr. E. S. Grumell, Mr. J. Hacking, Dr. H. Hollings, Prof. D. M. Newitt, Sir Harry Ricardo and Prof. S. Zuckerman. The terms of reference of the Council will be: (1) to advise the Minister of Fuel and Power on the scientific aspect of problems which he may remit to them in connexion with his statutory duty of securing the effective and co-ordinated development of coal, petroleum and other sources of fuel and power in Great Britain, and of promoting economy and efficiency in the supply, distribution, use and consumption of fuel and power, whether produced in Great Britain or not; (2) to advise the Minister of new scientific knowledge or developments which in the opinion of the Council should be taken into account in the performance of his statutory duties; (3) to keep the whole field of fuel and power under continuous review with the object of identifying problems needing scientific investigation and advising the Minister of those problems.

Ordnance Survey Maps of Britain

The initiation of an entirely new ordnance map series on a scale of 1 : 25,000, or about 2½ inches to the mile, was one of the chief recommendations of a departmental committee set up in 1935. It was felt that the gap between the 1-inch and 6-inch was too wide for many users. In the areas already covered there are signs that the new scale is growing in popularity. Some five hundred sheets, or about one fifth of the projected total, are now published, and it is hoped that the remainder will be ready in about three years time. The new map is based on the old six-inch map, to which has been added certain revisions made for war purposes. In this sense only is it provisional: the final edition will incorporate 50-in. re-surveys of built-up areas, now in hand in many towns, and an overhaul of 25-in. plans in rural areas. The sheet edges lie along the 10 kilometre grid lines of the national grid, and each sheet is known by the 10 km. grid reference of its south-west corner. The new map is sold in three styles, the fully coloured, the outline and the administrative areas. In the first, contours and main roads are in brown, water in blue, black for outlines of roads, buildings and railways, and solid black for public buildings. The outline edition is in grey monochrome without contours and is printed on specially heavy paper suitable for drawing offices. The administrative areas edition has all such boundaries shown by a red overprint on the outline edition; apparently it is being considered whether or not to continue the production of this edition. The following areas are now in the course of being covered by the 1 : 25,000 map: Greater London, Edinburgh, Glasgow, Dundee and Aberdeen; Plymouth and Dartmoor; Purbeck, New Forest, Southampton and Portsmouth, and most of the south coast; South Wales and Bristol; Gloucester, Oxford, Reading and Luton; East

Anglia and the Broads; Birmingham and district; Tyneside and Lancashire, Yorkshire and Cheshire. These maps, with the 6-in. to the mile, are known as 'medium scale'. Full descriptions of other Ordnance Survey maps, with illustrations and indexes, are given in two pamphlets, one dealing with small-scale maps and the other large-scale maps, issued by the Director General, Ordnance Survey Office, Chessington, Surrey (1*s.* 6*d.* each).

Research in Telecommunications

THE past decade has demonstrated the great importance of efficient and rapid communication as an essential part of modern civilization. Although in certain directions spectacular advances have been made in the development of telecommunications, which includes both radio and land-line signalling, there is more need now than hitherto for pursuing that fundamental research which underlies all the many applications of these techniques. In order to meet this need, the Department of Scientific and Industrial Research formed in 1946 an *ad hoc* Telecommunications Research Committee under the chairmanship of Sir Stanley Angwin, for the purpose of defining the basic problems in the whole field of telecommunications that would require investigation in the next few years. The Committee, which consisted of representatives of the radio industry, of those Government departments directly concerned with this subject, and of the British Broadcasting Corporation, drew up a report which has recently been published by the Department of Scientific and Industrial Research ("The Fundamental Research Problems of Telecommunications", London, H.M. Stationery Office, 1948. 1*s.* 6*d.* net).

This publication contains both the full reports and abstracts of the nine 'working parties' set up by the Committee to deal with the various phases of the subject. These working parties surveyed existing knowledge in their various fields to determine what deficiencies in that knowledge required attention; and they have indicated in considerable detail the specific items of research which appear to require investigation. It is believed that the formulation of these problems will prove a very useful step forward in the development of telecommunications research in Great Britain, and it is to be emphasized that university research laboratories, as well as those of government and industry, will find in the document many items suitable for their attention. With the issue of this report, the Committee has completed the task assigned to it: but the Department of Scientific and Industrial Research has already constituted a Standing Conference on Telecommunications Research, the function of which is to survey periodically the progress being made in this subject, and to provide a means for consultation between the Department's Radio Research Board and industry on these and other such matters of common interest.

Air Routes

THE advent and growing use of air transport has done a great deal to alter geographical values. Speed has reduced the importance of distance and thus recast many political, economic and social relationships. In a small pamphlet recently published ("Air Transport and Geography." London: Royal Geographical Society, 1947. 1*s.*), Mr. W. G. V. Balchin refers to many of the aspects of geography that touch on the course and uses of air routes. After referring to the vexed problem of air maps and their projections, he inserts a world map on an oblique zenithal equidistant projection centred on London and its antipodal point; on this the chief civil routes are shown. These maps show that 94 per cent of the world's population, and nearly all the world's manufacturing industry, fall in one of these hemispheres, and the central hub is in western Europe with London or Paris the actual centre. The distribution of population, especially of large urban growths, determines the course of the chief air routes. There are some forty-four world areas each of more than a million inhabitants, of which the largest are in Europe and the Atlantic side of North America and fewest in Africa and in Asia, outside China and Japan. The greatest number are on a great circle track through London and Melbourne. Major flying routes do not cross the Pacific, and contrary to often expressed belief, do not pass through north polar regions. Mr. Balchin goes on to consider other factors influencing the course of air routes.

Strawberries and Watercress as Commercial Crops

BULLETIN 95, "Strawberries" (London: H.M. Stationery Office. 2*s.* net), was originally published by the Ministry of Agriculture in 1937, but since that time so much new knowledge about the crop has become available that a new edition became necessary. This has now been accomplished with gratifying completeness, by co-operation between the scientific staffs of Long Ashton and East Malling Research Stations. All aspects of culture are discussed; but such items of practice as relate to the propagation and maintenance of healthy stocks receive special mention. One section deals with newer methods of out-of-season production, and an appendix describes the recognition of varieties. The section on diseases and pests is adequate; but prompts the gentle criticism that it is scarcely complete enough to deal with some troubles which are common in the northern part of Britain. Twenty-seven good half-tone figures add greatly to the value of the bulletin.

Watercress cultivation is a fascinating speciality. Bulletin 136 (London: H.M. Stationery Office. 1*s.* net) is written by Mr. Charles H. Sansom, and gives details of all aspects of this crop. Continuous growth is given by water at about 50° F., and it is often best to obtain this by boring through chalk to a depth of 300 ft. This special crop brings special pests, for the freshwater shrimp (*Gammarus* sp.) and caddis fly larvæ cause some damage, as well as the mustard beetle. Eight plates and diagrams show details of establishment and management of the beds.

Mushroom Diseases

BULLETIN No. 10 of the Mushroom Growers' Association (Yaxley, Peterborough. 2*s.* 6*d.* net) contains a brief note by F. C. Atkins and C. J. La Touche on *Pseudobalsamia microspora*, an ascomycete which may compete with the mushroom on commercial beds. It is almost certainly introduced with the surface soil and so can possibly be eliminated with care. Boards and the house-structure should be sterilized and flies kept down, as they spread the trouble. The same bulletin contains reprints of Dr. W. M. Ware's paper on "*Clitopilus cretatus* as an Invader of Mushroom Beds" (*Gard. Chron.*, May 18, 1935), and Dr. W. F. Bewley's work on mushroom casing soil (Cheshunt Exp. Sta. Ann. Rep., 1946). A separate leaflet lists useful volumes on mushroom culture in the Association's library.

Philosophy of Science

At a meeting held at University College, London, on June 1, a Philosophy of Science Group was formally constituted and affiliated with the British Society for the History of Science. The Group adopted the following statement of aims: "The purpose of the Group is to study the logic and method of science as well as of the various special sciences, including the social sciences. The main emphasis is upon an approach through the various special sciences to the philosophy of science." The Group intends to hold meetings for the reading and discussion of papers and to publish an account of its activities in a supplement to the *Bulletin of the British Society for the History of Science*, which will be circulated to members. The Group has elected the following Committee: Prof. H. Dingle (chairman), Dr. K. R. Popper, Mr. F. I. G. Rawlins, Dr. G. J. Whitrow and Dr. A. C. Crombie (honorary secretary), Department of History and Philosophy of Science, University College, Gower Street, London, W.C.1. It is hoped to hold the first ordinary meeting in the autumn of this year.

Conference on Noise and Sound Transmission

The Acoustics Group of the Physical Society, in association with the Royal Institute of British Architects, is holding a three-day International Conference on Noise and Sound Transmission during July 14–16. This is the first major international discussion of the subject for many years, and papers will be read by European and American investigators in addition to the contributions from Great Britain. Among those reading papers are L. L. Beranek (United States); T. Vogel, R. Lehmann, P. Chavasse, F. Canac (France); W. Fürrer (Switzerland); W. K. Westmijze, C. W. Kosten, J. van den Eijk (Holland); F. Ingerslev, V. L. Jordan, P. V. Bruel (Denmark); E. Meyer, A. Schoch, L. Cremer (Germany); N. Fleming, R. S. Dadson, H. L. Kirke, W. A. Allen and A. J. King (Great Britain). The papers will cover the subjects of sound insulation in buildings, aircraft and ships; impact sound; resilient suspension systems; proposals for standardization of measurement, and the measurement of noise. Those who desire to have copies of summaries of papers in advance of the meetings should send requests to the Joint Honorary Secretaries of the Acoustics Group at 1 Lowther Gardens, Prince Consort Road, London, S.W.7.

International Congress of Industrial Medicine

The ninth International Congress of Industrial Medicine will be held in London, at the Caxton Hall, during September 13–17. The last congress was held in Frankfurt in 1938. The congress will meet in six sections devoted respectively to social aspects, environment, nursing, clinical studies, practice and legal and miscellaneous topics. Among the subjects announced for discussion are incentives, work and skill, dust hazards, pneumokoniosis, physical, biological and psychological effects of environment, effects of working with the newer chemicals and metals, hazards of radiant energy, etc. Further particulars can be obtained from the secretary of the Congress, Room 501, Garden Court Wing, B.M.A. House, Tavistock Square, London, W.C.1.

Congress on Biological Chemistry

The Société de Chimie Biologique will hold its eighth congress in Paris during October 6–8. This will be the first international congress on the subject in France for ten years, the previous meeting having been held at Liège in 1946. Subjects for special consideration at the Paris congress are: proteins and hormones (reports by Profs. Theorell and Fromageot); biological organic chemistry and plant biochemistry (reports by Profs. Stoll and Janot); vitamins and hormones (reports by Profs. E. C. Dodds and Horeau). Sessions will also be reserved for communications outside these subjects, and provision will be made for experimental demonstrations. Further particulars can be obtained from the secretary-general of the congress, M. Jean Courtois, 4 Avenue de l'Observatoire, Paris, VI^e.

Science and Industrial Practice in the Iron and Steel Industry

The British Iron and Steel Research Association is arranging two conferences to be held next autumn at Ashorne Hill, nr. Leamington. The first, in which the Institute of Physics is also interested, will be held on September 8 and 9, and is to discuss non-destructive testing of castings. Three sessions will be arranged to discuss papers on X- and gamma-ray methods and on X-ray equipment, radioactive materials and radiography abroad; magnetic and ultrasonic methods; recent work by the Non-Destructive Testing Sub-Committee of the Association on the comparison of X-ray, gamma-ray and ultrasonic methods, and a paper on acceptance standards. It is intended that the papers shall deal essentially with the practical aspects of the subject and be of interest to executives not conversant with the methods, but who might be considering their use. The second conference is planned for October 21 and 22, and is to discuss foundry core bonding agents. The object is to bring to the notice of founders the wealth of information that has been obtained in recent years on the new materials that may be used for the bonding of foundry cores. The use of such materials, in many cases with an appreciable reduction in cost, would enable the linseed oil used hitherto to be diverted to alleviate the shortage of edible fats. There will again be three sessions: natural resources of the materials, recent work by the Association on the practical and fundamental aspects of bonding, and the properties of new materials such as plastics and petroleum products; experience of founders with such materials; and the impact of these materials on matters such as core-blowing, and dielectric and infra-red heating.

International Scientific Film Congress

The second congress of the International Scientific Film Association will be held in London during October 4–11. It is being convened by the Scientific Film Association of Great Britain, with the help of the British Film Institute. Three days will be devoted to business meetings of the Association, and three days to a festival of scientific films, when it is hoped to show many contributions from all the participating countries to members of the general public. The congress will close with a general assembly of the delegates on October 11. The Association was constituted last year in Paris by delegates from twenty-two countries who had accepted the joint invitation to the inaugural congress from the Scientific Film Associations of Great Britain and France. The primary aim of the Association is: "To raise the standard and to promote the use of the scientific film and related material throughout the world in order to achieve the widest possible understanding

and appreciation of scientific method and outlook, especially in relation to social progress". Further details may be obtained from the Scientific Film Association, 34 Soho Square, London, W.1.

Annual Reviews of Psychology and of Physical Chemistry

An "Annual Review of Psychology" is to be published under the auspices of Annual Reviews, Inc., Stanford, California, the first volume to appear early in 1950. Prof. Calvin P. Stone and Donald W. Taylor, of Stanford University, will serve as editor and associate editor, respectively. The editorial committee will consist of the following: John E. Anderson, Institute of Child Welfare, University of Minnesota; John G. Darley, University of Minnesota; Clarence H. Graham, Columbia University; Carl I. Hovland, Yale University; James G. Miller, University of Chicago. The subject-matter of each volume will consist of critical appraisals of research proceeding in the major divisions of the field. Subjects of greatest activity will be reviewed annually, while those of lesser activity, together with any topics which encompass small divisions of the field, will be reviewed biennially.

Organisation of an "Annual Review of Physical Chemistry" of a similar type, operating under the same editorial policies and characterized by a corresponding recurring list of topics, is also announced by Annual Reviews, Inc. This will be edited by Prof. G. K. Rollefson, of the University of California, Berkeley, and will be directed in the selection of topics and authors by an editorial committee consisting of Henry Eyring, University of Utah; George Glockler, State University of Iowa; W. F. Libby, University of Chicago; J. W. Williams, University of Wisconsin; and E. Bright Wilson, jun., Harvard University. The first volume will also appear in 1950. Annual Reviews, Inc., is a non-profit corporation which was first constituted in 1932 to publish the "Annual Review of Biochemistry". Since then it has initiated the "Annual Review of Physiology" (jointly with the American Physiological Society) and the "Annual Review of Microbiology".

Zoological Society of India

The following have been elected members of the Executive Council of the Zoological Society of India: *President*, Dr. S. L. Hora; *Vice-President*, Prof. D. R. Bhattacharya; *Secretary*, Dr. M. L. Roonwal; *Editor*, Prof. K. N. Bahl; *Treasurer*, Dr. B. S. Chauhan; *Members*, Dr. K. Panikkar, Prof. M. A. Moghe, Dr. B. N. Chopra, Dr. Bhattacharya, Dr. G. D. Bhalerao, Dr. D. V. Bal, Dr. T. J. Job. It is intended to bring out the first volume of the *Journal of the Zoological Society of India* this year. Papers intended for publication, which should be original contributions or critical reviews of current researches not published elsewhere, should be sent either to the Editor (at the Zoology Department, Lucknow University, Lucknow) or to the Secretary (at the Zoological Survey of India, Banaras Cantt., U.P.).

University of Glasgow

The University Grants Committee is supporting the development of electrochemistry in the University of Glasgow; and Dr. J. C. James, at present at Battersea Polytechnic, London, has been appointed lecturer in chemistry under this project. Similar support is to be given to zoological taxonomy. Other recent appointments in the University of Glasgow are: Mrs. Rhoda M. Ainley, assistant in anatomy; J. Highet, lecturer in sociology; A. W. Sloan, lecturer in physiology; Bruno Toushek, a Nuffield fellow in physics; Mrs. Jean A. Wapshaw, part-time assistant in biochemistry; and A. Williams, lecturer in geology (with a year's leave of absence while holding a Commonwealth fellowship).

Work has been begun on the final portion of the new Chemistry Department at Glasgow, and on the building which is to house the 300-MeV. synchrotron. A 30-MeV. instrument is already in operation in the Department of Natural Philosophy.

Announcements

Prof. T. Dalling, director of the Veterinary Laboratory of the Ministry of Agriculture and Fisheries at New Haw, Weybridge, has been appointed chief veterinary officer to the Ministry from August 21 on the retirement of Sir Daniel Cabot, who has reached the age of sixty. Sir Daniel Cabot's services will be retained part-time in a temporary capacity in connexion with certain international veterinary organisations.

Mr. Alfred Eastham, chief officer of the Official Seed Testing Station since 1923, retired on June 30 and the Council of the National Institute of Agricultural Botany has appointed Mr. C. C. Brett to this post. Mr. Brett has been senior assistant to the chief officer since 1922, and during the past eighteen months has been seconded as executive officer of the Seed Production Committee.

The following have been appointed to readerships in the University of Edinburgh: Mr. E. G. Dymond (natural philosophy), Dr. W. L. Edge (mathematics), Dr. Alexander Nelson (botany) and Dr. E. G. V. Percival (chemistry).

The autumn meeting of the Deutsche Physikalische Gesellschaft in der Britischen Zone will take place at Clausthal-Zellerfeld/Harz during September 9–12.

The fourth Commonwealth Mycological Conference will be held at the Imperial College of Science and Technology, South Kensington, during July 19–24. Plant pathologists from all parts of the British Empire will be present, and the topics to be discussed include the control of virus diseases, with special reference to swollen shoot of cacao, measures to be taken to avoid the transmission of seed-borne parasites through the seed, the certification of healthy planting material of certain vegetatively produced crops, new developments in fungicides, including their application from the air, and forest pathology.

At the annual general meeting of the Institute of Welding on June 30, the following were elected honorary officers for 1948–49: *President*, Dr. J. H. Paterson; *Vice-President*, O. V. S. Bulleid; *Honorary Treasurer*, W. E. Harriss.

The Governing Body of the Imperial College of Science and Technology has decided that the schemes for the international exchange of students during summer vacations, initiated by its Vacation Work Committee in 1946, shall be broadened in 1949 to include university students from other colleges in Great Britain. The exchange is operated through the recently established International Association for the Exchange of Students for Technical Experience, which at present includes Belgium, Czechoslovakia, Denmark, Finland, France, Netherlands, Norway, Sweden and Switzerland.

LETTERS TO THE EDITORS

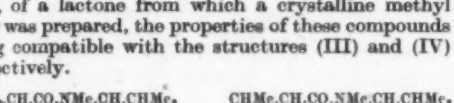
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Antibiotics Produced by Fungi, and a New Phenomenon in Optical Resolution

It was reported earlier[1] that a strain of *Fusarium lateritium* produced an antibiotic, lateritiin-I, which was representative of a group of related compounds in presenting several remarkable chemical features. These features were elaborated in a communication to the Eleventh International Congress of Pure and Applied Chemistry held in London in July 1947, in which it was stated that lateritiin-I gave rise on hydrolysis to *D*(−)-α-hydroxy*iso*valeric acid and *L*(+)-*N*-methylvaline (II). The different configurations of these products were an indication, taking

$CHMe_2.CH(OH.)CO_2H$ (I) $\qquad$ $CHMe_2.CH(NHMe)CO_2H$ (II)

their configurational stabilities into account, that these units had an individual existence in the original antibiotic. This conclusion was supported by the isolation from lateritiin-I, after mild alkaline hydrolysis, of a lactone from which a crystalline methyl ester was prepared, the properties of these compounds being compatible with the structures (III) and (IV) respectively.



(III) $\qquad$ (IV)

Meanwhile Gaumann, Roth, Plattner, Ettlinger and Nager[2] had, unknown to us, reported the production by a strain of *F. orthoceras* of enniatin, which appeared to be closely related to, if not identical with, lateritiin-I. After exchanging samples of the two materials, it is agreed by Prof. Plattner and by us that a mixture of them is undepressed in melting point and that they must be regarded as identical. However, in a paper which has only recently reached us[3], it is concluded that the simple nitrogenous acid hydrolytic fragment of enniatin is probably identical with the higher homologue of (II), namely, *N*-methylleucine.

It seems, therefore, desirable to report that the structure of the fission product under discussion has been completely established by oxidation and by synthesis. Oxidation afforded *iso*butyraldehyde, which was identified as its 2 : 4-dinitrophenylhydrazone and 2 : 4-dinitrophenylsemicarbazone. Interaction of methylamine and lævo-α-bromo*iso*valeric acid afforded *L*(+)-*N*-methylvaline, identical in all respects with the material of natural origin; this was also obtained by the methylation of *L*(+)-valine in the usual way. Any remaining structural doubt has been removed by the synthesis of the lactone (III) and the derived ester (IV) in the following way. *lævo*-α-Bromo*iso*valeryl chloride and *DL*-*N*-methylvaline were condensed together and the product was refluxed with pyridine and water, when the hydroxy-acid condensation product was formed. This was extracted and heated for several hours on the steam bath under reduced pressure, when the lactone (III) was obtained as a viscous oil similar to the natural material. This had the rotation $[\alpha]_D = +52°$ (ethanol); but on passing it through an acid-washed column in ethereal solution, about half the material was lost and the remainder had the rotation $[\alpha]_D = +79°$ (ethanol). The natural lactone has the rotation $[\alpha]_D = +82°$ (ethanol). On mild alkaline hydrolysis the synthetic material reverted to the hydroxy-acid, which on treatment with diazomethane gave the methyl ester (IV) identical in melting point with the ester of natural origin, with which it gave no depression on admixture; it was identical in all other respects with the material obtained by degradation, both showing the same optical activity, $[\alpha]_D = -128°$ (chloroform). Finally, the synthetic material yielded *L*(+)-*N*-methylvaline on hydrolysis.

The above reactions virtually constitute a facile resolution of *N*-methylvaline; apparently the lactone derived from *D*-α-hydroxy*iso*valeryl-*D*-*N*-methylvaline is more strongly absorbed on the alumina than that derived from *D*-α-hydroxy*iso*valeryl-*N*-methylvaline and undergoes hydrolysis. The lactone and derived hydroxy-acid pairs are, of course, not mirror images and no new theoretical principle is involved, nor is this an asymmetric synthesis in the conventional sense. The process is, however, unexpectedly simple; it might have considerable utility if it were general, and it clearly offers interesting speculation on the genesis of optically active amino-acids from existing optically active compounds.

Using the same procedure and starting with *DL*-α-brom*iso*valeryl chloride and *DL*-*N*-methylvaline, a crystalline optically inactive lactone was obtained, which was also formed by mixing equal amounts of the natural lactone with that derived from *L*-α-hydroxy*iso*valeryl-*D*-*N*-methylvaline.

A number of lactones similar to (III) have been made and are being studied, and full details of the present and related work will be published elsewhere.

Note added in proof.—Since the above was written a further communication (Plattner, Pl. A., and Nager, U., *Helv. chim. Acta*, **31**, 665; 1948) has come to our notice in which 'enniatin A' and 'enniatin B' were described. Of these 'enniatin A', which appeared to be identical with lateritiin-I, afforded *N*-methylleucine, while *N*-methylvaline arose from 'enniatin B'. The above authors suggested that lateritiin-I was highly contaminated with 'enniatin B'. It must be emphasized, however, that we find no evidence to support this contention, the various degradation products affording no sign of heterogeneity.

A. H. Cook
S. F. Cox
T. H. Farmer

Imperial College of Science and Technology,
London, S.W.7. March 24.

[1] Cook, A. H., Cox, S. F., Farmer, T. H., and Lacey, M. S., *Nature*, **160**, 31 (1947).
[2] Gaumann, E., Roth, S., Plattner, Pl. A., Ettlinger, L., and Nager, U., *Experientia*, **3**, 202 (1947).
[3] Plattner, Pl. A., and Nager, U., *Experientia*, **3**, 325 (1947).

The Antibiotic Agent from *Marasmius ramealis*

It has earlier been shown that species of the genus *Marasmius* produce substances inhibiting the growth of *Staphylococcus aureus*[1]. Our investigations now show that *Marasmius ramealis* Fr. exercises an antibiotic effect upon various pathogenic bacteria *in vitro*.

The *Marasmius* strain used was isolated and investigated for nutritional requirements by Lindeberg[2]. The fungus was grown upon different media, the most suitable one being a modification of the Czapek-Dox substrate. Erlenmeyer flasks containing 25 ml. of the nutrient solution were inoculated and incubated at 25° C., and the culture liquid tested for anti-

bacterial activity at different intervals against: (1) bacteria named in the accompanying table (State Bacteriological Laboratory) and (2) human tubercle bacilli (Institute of Physiological Botany).

The inhibitory action against the former bacteria was tested on solid media using a modification of the cylinder plate method due to Schmidt and Moyer[3], and in dilution series in broth. The solid medium was buffered with phosphates to neutralize the bacteriostatic effect caused by an acid solution. The bacterial concentration in the surface layer was 10^{-4} or 10^{-5} of a 20-hr. broth culture, giving a confluent growth. The plates with porcelain covers were kept at room temperature two hours before incubation at 37° C. overnight. The zones of total inhibition were read to the nearest 0·5 mm. The action on different bacteria is shown in the table.

Dilution tests were performed in broth with inocula of about 10,000 organisms per ml. The last tube showing no visible growth was determined after 20 hours incubation at 37° C. (see table). It was evident from secondary platings of the tubes that the antibacterial action was a bacteriostatic one.

	Inhibition zone (mm.)	Max. dilution for inhibition
Staphylococcus aureus, H	23·0	1/32
Staphylococcus aureus, 209 *P*	22·0	1/16
Streptococcus haemolyticus, S.B.L.	0	
Diplococcus pneumoniæ, S.B.L.	28·0	
Klebsiella pneumoniæ, Friedländer *C.G.* 8	27·0	1/8
Salmonella typhi, I.S. 57	13·0	1/4
Salmonella paratyphi B, I.S. 3	10·0	1/2
Escherichia coli, C.G. 16	0	
Aerobacter aerogenes, C.G. 4	15·0	1/2
Shigella sonnei, S.B.L. 5	9·0	1/2
Proteus vulgaris, S.B.L. 2	19·0	1/2
Facalis alcaligenes, S.B.L.	14·5	1/8
Pseudomonas aeruginosa, S.B.L.	0	
Bacillus subtilis, 219 *P*	42·0	1/256
Bacillus anthracis, S.B.L. 1	30·0	1/16
Corynebacterium diphtheriæ mitis, S.B.L.	0	
Hemophilus pertussis, S.B.L.	0	

For the tubercle bacilli, the serial dilution method was used. The *Mycobacterium* cultures employed were two strains of *M. tuberculosis* var. *hominis*: the *H* 37 *Rv* strain (obtained through Dr. Lagergren, of the State Bacteriological Laboratory, Stockholm) and the 1354 strain (isolated by Dr. Zetterberg, Institute of Hygiene and Bacteriology, University of Uppsala). The inhibitory effect upon *H* 37 *Rv* was studied only in Dubos' medium[4]; with the 1354 strain, the dilutions were made in different media: veal broth, Long's and Dubos' solutions. After the addition of the active filtrate to the substrate, the *p*H of the liquid was adjusted to about 7 with sodium hydroxide. The flasks with Dubos' medium were inoculated with a suspension of the bacteria, the other substrates with small floating pieces of the pellicle. Control flasks containing dilutions of the basal fungus nutrient solution were also seeded. The flasks were incubated at 37° C.

Dilutions of 1/3, 1/5 and 1/11 in Erlenmeyer flasks were used for routine tests. The flasks were examined at intervals of three days; but no visible growth could be detected in any medium after two months of incubation. In the controls the bacteria grew vigorously. Dilution experiments were also carried out in glass tubes, the growth being measured photometrically. After about three weeks a slight growth was found in the 1/50 dilution. In the tubes with the 1/30 dilution bacterial reproduction was completely inhibited (two months of observation). The two *Mycobacterium* strains tested behaved in a similar manner.

The antibacterial material has been separated from the culture medium in two different fractions, both showing an inhibitory effect against the two *Mycobacterium* strains. On distillation of the culture filtrate *in vacuo* (bath temperature 15° C.), a colourless, aqueous distillate of *p*H 6·5, showing activity, was collected in the receiver. The distillation was continued, while maintaining the volume in the distillation flask constant by adding water, until the distillate showed no activity. The aqueous distillate, containing the active principle, was extracted with small portions of ether or chloroform and the solvent removed under reduced pressure, leaving an oily residue, soluble in ether, petroleum ether and chloroform, and fairly soluble in water. All the active material could not, however, be removed by distillation; the rest was extracted with ether from the culture medium left after distillation, the *p*H being adjusted to 1·5–2·5. The ether was removed under reduced pressure leaving an orange-yellow residue, not volatile but readily soluble in water, ether, chloroform and ethyl alcohol.

The *volatile* substance can also be isolated from the antibacterial filtrate by extraction with chloroform, which does not remove the *non-volatile* principle, or by adsorption on activated charcoal ('Norit'), followed by elution with chloroform or ether.

Aqueous and ethereal solutions, or a dry preparation of the *volatile* substance, undergo a chemical change on standing at room temperature, yielding an inactive, yellow residue, which is no longer soluble in water or ether. Stored at + 2° C., however, an aqueous solution can keep its activity for at least one month. Potassium permanganate solution and bromine water are decolorized by the substance in question, which also gives a precipitate with a mercuric chloride solution.

These preliminary investigations of the *volatile* substance indicate a certain resemblance to allicin, the antibacterial principle of *Allium sativum*[5,6]. As to the *non-volatile* substance, it can be extracted with ether only from acidified aqueous solutions. If it is kept at room temperature in a dry state or in solution, there is no appreciable change in its inhibitory effect for at least five weeks.

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Utilization of Mineral Constituents of the Egg-shell by the Developing Embryo of the Stick Insect

THE presence of a relatively large quantity of mineral material, mainly calcium carbonate, in the egg-shell (exochorion) of Phasmidæ has been established by Pantel[1] (in eggs of *Donusa prolixa*). Extending his examinations to the egg content, Pantel found that the Malpighian tubules of fully developed embryos contained calcium salts far in excess of the

quantity which he was able to demonstrate in the yolk of freshly laid eggs. Pantel interpreted this finding by assuming that most of the calcium in the yolk was organically bound and therefore not responsive to his methods of detection.

The egg-shell of *Bacillus libanicus* Uv. contains, besides calcium carbonate, also calcium oxalate and smaller quantities of aluminium, magnesium and potassium salts. Most of the calcium carbonate is concentrated in a white crystalline layer covering the inner surface of the shell. In freshly laid eggs, this white layer appears dense and opaque, its compactness and structure being the main cause of the rigidity of the egg-shell. It was observed that in the shells of fully developed or hatched-out eggs, the white layer is much reduced in thickness, the whole shell being less opaque and more brittle. A similar appearance could be produced in shells of freshly laid eggs by emptying them and immersing in water acidulated with carbon dioxide.

Considering these differences in thickness of the white layer, and in view of Pantel's observation, there arose the question whether during embryonic development mineral material from the egg-shell might not be passing into the egg-content. The possible occurrence of such a process in insect eggs was originally suggested by Needham[2], in view of the fact that in some avian and reptilian eggs utilization of egg-shell calcium by the developing embryo had been demonstrated[3,4].

To test this possibility, the quantities of ash in shells and in contents of eggs at various stages of development were determined and compared. As eggs laid by different females may vary considerably with regard to their ash content, only eggs of the same parentage were used for comparative measurements.

Material	% of ash in terms of dry weight in	
	Shells	Egg contents
Freshly laid eggs	38·4	0·7
Eggs entering diapause (age, 80 days)	35·4	1·1
Post-diapause eggs (10 days before hatching)	32·7	2·3
Eggs at hatching	30·8	3·5* (Neonate nymphs)
One-year old, undeveloped eggs	38·0	0·6

* The actual rise in ash quantity is somewhat lower, there being a corresponding decrease of about 6·4 per cent in the dry weight of the egg due to the development of the embryo.

The accompanying table summarizes some of the results concerning changes in the relative quantity (in terms of dry weight) of the mineral components in shells and in contents of developing and undeveloped eggs laid by one female. It shows clearly that in the shells of developing eggs the quantity of the mineral components decreases continuously, its percentage in dry shell weight diminishing by about 8 per cent; no such change is observable in shells of eggs which do not undergo development. Further, the quantity of the mineral material in the developing embryo rises markedly, there being no such rise in the undeveloped one-year-old eggs.

Thus it seems safe to conclude that during development of the egg of *B. libanicus*, a transfer occurs of mineral material from the egg-shell to the developing embryo. Although it was not possible to carry out a quantitative identification of the transferred minerals, the morphological observations mentioned above suggest that it is mainly calcium carbonate from the white layer of the shell that is absorbed by the embryo.

A more detailed account will be published elsewhere.

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Function of Hyaluronidase in Fertilization

Pincus[1] and Pincus and Enzmann[2] observed that the mass of follicle cells surrounding the freshly ovulated rabbit egg could be dispersed by means of sperm suspensions, and they inferred the presence of a proteolytic enzyme. Gilchrist and Pincus[3], describing the events taking place during *in vivo* fertilization in the rat, state that the freeing of adherent follicle cells is "an inevitable accompaniment of sperm penetration . . .". Afterwards, McClean and Rowlands[4] and Fekete and Duran-Reynals[5] produced evidence to show that the enzyme is probably hyaluronidase. They also expressed the view that the denudation of the egg is a necessary preliminary to the penetration of the sperm, and this theory, and the important role thus ascribed to hyaluronidase, have become widely accepted.

It should be noted, however, that Lewis and Wright[6] concluded from their investigations on the mouse egg that sperm penetrate to the vitellus "long before" the dissolution of the surrounding mass of follicle cells. Their evidence consisted chiefly in the finding of sperm in the perivitelline space of the freshly ovulated egg, and the extrusion of the second polar body when the eggs were kept in culture. They were, however, unable to observe pronuclei or sperm within the vitellus in their material. For some reason the evidence presented by Lewis and Wright appears to have been overlooked by the protagonists of the present concept of the function of hyaluronidase in fertilization.

During an investigation of fertilization in the rat, it has been observed that if females are killed when the copulation plug is found, the eggs are recovered in cumulus masses of varying degrees of integrity. Frequently the cumuli are indistinguishable under the microscope from those obtained from unmated rats. Nevertheless, most of the eggs show sperm within the vitellus, and when examined under the phase-contrast microscope, the male and female pronuclei can also be discerned. This means that an appreciable time, perhaps an hour or more, has elapsed since sperm penetration. In other cases, eggs observed in cumuli in varying degrees of disintegration show pronuclei of progressively greater size and more complex structure. It is clear, therefore, that in the rat the disintegration of the cumulus occurs over a period following fertilization.

A similar state of affairs appears to exist in the cat, for Prof. E. C. Amoroso (personal communication) has demonstrated the presence of sperm in the zona pellucida of the cat's egg while the latter was still surrounded by an apparently intact layer of follicle cells.

It is concluded that the penetration of the intact cumulus by the sperm as envisaged by Lewis and Wright does, in fact, occur, and that denudation of

the egg, at least in some species, is not a prerequisite of fertilization. Clearly, therefore, the destruction of the cumulus prior to sperm entry is not an essential function of hyaluronidase, though the local presence of the enzyme may conceivably assist the passage of the individual sperm.

Illustrations of fertilized eggs in apparently intact cumuli, together with details of microscope technique, will be included in a full paper being prepared, in collaboration with Mr. J. Smiles, for submission to the *Journal of the Royal Microscopical Society*.

I wish to record my grateful acknowledgments to the Medical Research Council and Dr. C. R. Harington for the hospitality of the National Institute for Medical Research, Hampstead, and to Dr. A. S. Parkes and Prof. E. C. Amoroso for their valuable criticism and advice.

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Metabolism of Aminohydroxybenzoic Acids

We have recently been studying the metabolism of some aminohydroxybenzoic acids. In view of the interest in these compounds which has been stimulated by the observations of Lehmann[1], Vallentin[2] and of Dempsey and Logg[3] of the beneficial effects of 4-aminosalicylic acid (*P.A.S.*) on patients with various tuberculous lesions, a preliminary statement of some of our results seems opportune.

We have already identified some aminohydroxybenzoic acids (or amides) as metabolites of aminobenzamides in the rabbit[4]; for example, 3- and 5-hydroxyanthranilic acids from *o*-aminobenzamide, 5-aminosalicylic acid from *m*-aminobenzamide and 4-amino-3-hydroxybenzoic acid from *p*-aminobenzamide. It is our intention to study the metabolism of the ten isomeric aminohydroxybenzoic acids, and so far we have carried out a preliminary examination of four, namely, 3-, 4- and 5-aminosalicylic acids and 3-amino-4-hydroxybenzoic acid. The three aminosalicylic acids appear to be metabolized by the rabbit in similar ways, being excreted partly unchanged and partly as acetamidosalicylic acids, all three of which have been isolated from the urine. No increase in ethereal sulphate excretion was observed. (Salicylic acid itself is not excreted as ethereal sulphate[5].) 3-Amino-4-hydroxybenzoic acid, however, does appear to be conjugated with sulphuric acid to a slight extent (about 4 per cent), as well as being excreted unchanged and as 3-acetamido-4-hydroxybenzoic acid.

Owing to its clinical interest and to the kind co-operation of Mr. D. E. Seymour, of Herts Pharmaceuticals, Ltd., in supplying us with the compound, we are examining 4-aminosalicylic acid in somewhat greater detail. In the rabbit, approximately 50 per cent of a dose of 1–2 gm. is excreted unchanged and 50 per cent as 4-acetamidosalicylic acid (m.p. 238–239°), which has been isolated and characterized. There has, so far, been no evidence of the formation of ethereal sulphate or of glucuronides of either ester or ether type. 4-Acetamidosalicylic acid has also been isolated from human urine after oral administration of 3 gm. sodium 4-aminosalicylate. Considerable amounts were excreted unchanged.

A fuller account of this work will be published elsewhere.

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Lipoid Content of the Oxyntic Granules of the Rat's Stomach

There have been a few suggestions in the literature that the granules of the oxyntic cells of the stomach might consist in part of a lipoid material. The evidence for this view has, up to date, been circumstantial, having been based on (*a*) the tendency of these granules to show some blackening after fixation in fluids containing osmium tetroxide[1], and (*b*) the assumption that, since they can be readily demonstrated by the Altmann – Regaud technique[2] and can be supravitally coloured by Janus Green *B*[3] they are mitochondria, and therefore contain lipoid.

Recently, more positive evidence for a lipoid component has been forthcoming. Foster[4], using a method by Baker[5], has shown that these granules have, in frozen sections of formol calcium chloride fixed rat's stomach, a strong affinity for Sudan Black (Fig. 1),

Fig. 1 Fig. 2 Fig. 3

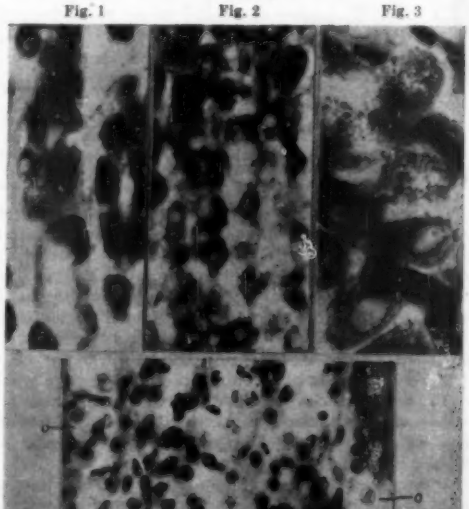

Fig. 4

Figs. 1, 2 and 4. × 375. Fig. 3. × approx. 800. Fig. 4. O, oxyntic cell. Note positive reaction of nuclei after pyridine extraction

a fact strongly indicative of the presence of lipoid. I have confirmed these observations, and extended them by the use of Baker's acid hæmatin test[4] for lipines.

The oxyntic cells of the rat's stomach are strongly positive to the acid hæmatin test (Figs. 2 and 3) and therefore very probably contain lipine, although some oxyntic cells at the bases of the fundic glands are negative, showing only the unstained refractile granules. There is reason for believing that this is not a fixation artefact, or some similar effect, related to the technique employed, but that it represents a specific functional state of the cells in these positions.

After removal of the lipoids by the pyridine extraction method[4], the acid hæmatin test gave negative results (Fig. 4). It was quite clear, however, that the cells still contained refractile granules, comparable in numbers to those of the non-extracted cells, and it was possible to stain these with Heidenhain's iron hæmatoxylin. It seems reasonable to suppose, at this stage of the investigation, that these extracted granules consist partly of protein. If this is so, the oxyntic granules appear to be of a duplex nature, consisting of a protein core and a lipine (and perhaps non-lipine lipoid) envelope. In this respect they resemble not only mitochondria, but also the lipoid-invested vacuoles of the Golgi complex.

A preliminary study of the behaviour of these granules under certain experimental conditions that stimulate gastric secretion has shown (*a*) that in some cells there is a very marked enlargement of the granules, and an intensification of their positive reaction to acid hæmatin, and (*b*) that in others, perhaps the majority, there is a negative reaction to the acid hæmatin test, suggesting that in these cells the granules have lost their lipine component.

A full account of these and other observations on oxyntic and other chloride-secreting cells, their probable relation to mitochondria and the Golgi complex, and their possible relation to the mechanism of hydrochloric acid secretion, will be given elsewhere.

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Discriminating 'Athrocytes' in the Reticulo-endothelial System

'ATHROCYTOSIS' can be defined as the property of some types of cell (termed 'athrocytes') of absorbing and storing in granular form extraneous substances, mostly electronegative colloids. Lison[1] showed recently that the Kupffer cells of the frog and toad liver do not all have this property to the same extent. Some—provisionally termed '*G*' cells—store certain electronegative dyes, namely, those in which the diameter of the particles is greater than 60–80 A. Others ('*F*' cells) accumulate preferentially those of smaller diameter. This behaviour is clearly seen when a frog is injected intraperitoneally with a mixture of two acid dyes the particulate diameters of which are respectively greater and less than 80 A.; for example, a mixture of soluble Prussian blue (228 A., calculated by means of Einstein's formula from the diffusion coefficient measured with a Nistler's diffusion microscope) and ammonium carmine (20·5 A.). In these conditions, the '*G*' Kupffer cells take up only the blue, the '*F*' cells only the carmine.

Both cell types are 'discriminating athrocytes' according to the definition of Cordier, Gérard and Lison[2]: they select among the athrocytable substances, taking and storing some of them, neglecting the others. In this case, it was shown conclusively that the main factor controlling the selection is the dimension of the particle in solution (other types of discriminating athrocytosis have been described by Lison[3]).

The purpose of this communication is to present evidence of the existence of such discriminating athrocytes in the reticulo-endothelial system of mammals. The technique used in our experiments was the intraperitoneal injection into the rat of suitable mixtures of acid dyes. In contrast with the common practice in the investigations on the reticulo-endothelial system, one single injection was made, and the quantity of the dye injected was relatively small—in most experiments 0·01 gm. of each dye. Preliminary experiments showed that high doses of dyes and repeated injections result in strong reaction of the reticulo-endothelial system, involving mobilization of many cells and fundamental changes in the characteristics of its components. The dyes used were all non-dialysable electronegative dyes; and they can be divided into two groups: 'high-dispersion' dyes, for which the diffusion coefficient is less than $0{\cdot}050 \times 10^{-5}$ cm.^{2}/sec., corresponding to theoretical particulate dimensions less than 80 A.; and 'low-dispersion' dyes, for which the diffusion coefficient is greater than this value. This classification is merely a question of convenience and is adopted for reasons of clarity only.

The most striking results are obtained with mixtures of one 'high' and one 'low' dispersion dye. After one day, the two components appear to be nearly quantitatively separated and are found stored in granular form in different cells. The high-dispersion dye is accumulated in fine and medium-sized granules in elongated, spindle-shaped cells. These fixed cells are found throughout the connective tissue surrounding or penetrating the organs and must be regarded as 'histiocytes'. The low-dispersion component of the mixture is stored in medium- or large-sized granules in large polymorphous mobile cells with rounded or reniform nuclei. These cells, which are rather scarce in the common connective tissue, but are very numerous in the medullary of the lymphatic nodes and in the omentum, must be identified with 'free macrophages'. The greatest part of the dyes injected is found separately in these two cell types. In addition, a few cells store both components in the form of mixed granules. These cells, macrophagic in aspect, must be considered as transitional elements between histiocytes and macrophages for the following reasons: they occur in the regions where the production of free macrophages is intense, such as the medullary of the lymphatic nodes and the omentum: the granules are formed of various relative proportions of the two dyes, in such a way that all the transitions can be observed.

The high-dispersion dye appears in the histiocytes throughout the whole body, while the athrocytosis of the low-dispersion dye is restricted to the area near the point of injection, that is, in the abdominal and sometimes mediastinal lymphatic nodes, in the omentum, and in the connective tissue in the immediate neighbourhood of the abdominal cavity. It is evident that the resorption and the transportation of the low-dispersion dyes are much slower than those of the high-dispersion ones, resulting in a more restricted area of athrocytosis. It must be emphasized, however, that the storage of the two dyes in different types of cell is not the result of circulatory conditions, preventing the access of one dye to one type of cells, since both types of athrocytes can be seen in the same location closely packed together.

In the liver, also, the two dyes are found in separate cells. The Kuppfer cells selecting the high-dispersion dye are scattered equally in the whole lobule, while the cells which store the low-dispersion dye are restricted to the periphery of the lobule, near the interlobular veins. Thus the two types, '*G*' and '*F*', of the Kuppfer cells previously described in amphibians occur also in mammals, but their location is different.

When the two components of the mixture used in the previous experiments are injected separately their location is the same as if they were injected simultaneously.

When mixtures of two high-dispersion dyes are injected, the two components are not separated, but are stored in the same cells, mainly in the form of mixed granules; these findings are in accordance with the observations of von Möllendorff. When mixtures of two low-dispersion dyes are injected, the two components are found both in the same macrophages, sometimes in the form of mixed granules, more often in the form of separate granules; cells with only one component are not found.

The present experiments afford evidence that the athrocytes in the reticulo-endothelial system of mammals act selectively towards different substances, and that the main factor controlling the selection is the dimensions of the particle in solution. Therefore, substances of different dispersions are stored in different cell types, the critical value of the dispersion corresponding approximately to a diffusion coefficient of $0{\cdot}050 \times 10^{-5}$ cm.^{2}/sec.

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A Further Example of the Anti-*S* Agglutinin

A second example of the human hæmagglutinin, anti-*S*, discovered by Walsh and Montgomery[1] has been identified. This agglutinin was shown by Sanger and Race[2] to be connected with the *MN* blood-group system, and to define either two more allelomorphs, *MS* and *NS*, at this locus, or else a second locus *S*, very closely linked to that for *M* and *N*. For practical purposes there is no difference between these two alternative possibilities.

The present example was found together with an anti-*D* agglutinin in the serum of a patient whose second pregnancy terminated in a stillborn hydropic fœtus at twenty-eight weeks gestation. The serum was first tested with a series of 48 *Rh* negative bloods, of which 22 were found to be agglutinated. It showed no relationship to *ABO*, *P*, Lewis or Lutheran blood groups, though there was suggestive evidence that it was connected with the *MN* groups, for, of the bloods of group *M*, eight were positive and five negative, and of those of group *N*, two were positive and six negative. Differential absorption was successfully achieved with three out of four *Rh* positive bloods chosen at random, the fourth donor removing all agglutinins.

The bloods of 250 unselected non-related people have been tested with the absorbed serum, and the results are given in Table 1 with the two previously published series. Dr. R. R. Race has also tested the bloods of 21 known *S* positive and 15 *S* negative individuals with the new serum, with complete agreement in all cases.

Table 1

	M		*N*		*MN*			
	S+	*S*−	*S*+	*S*−	*S*+	*S*−	Total	*S*+%
Walsh and Montgomery[1]	30	9	13	21	40	27	140	59·3%
Sanger and Race[2]	36	14	15	30	57	38	190	56·9%
Oxford series	55	20	12	33	67	63	250	53·5%
	28·28%		21·38%		50·34%		580	56%

A total of 580 bloods have now been tested with the two examples of the anti-*S* antibody, and the distribution of the *MN* groups is in good agreement with that expected in England. Prof. R. A. Fisher has very kindly recalculated the gene frequencies[3] for the combined data (Table 2).

Table 2

	S+	*S*−	Total
M	0·25585	0·27863	0·53448
N	0·08113	0·38439	0·46552
Total	0·33698	0·66302	1·00000

From these gene frequencies the expected genotype frequencies can be calculated (Table 3).

Table 3

Phenotypes	Genotypes	Expected	Observed	χ^2
M *S*+	*MSMS*, *MSM*	120·6921	121	0·0008
M *S*−	*MM*	44·9958	43	0·0885
MN *S*+	*MSN*, *MSNS*, *MNS*	164·3819	164	0·0001
MN *S*−	*MN*	124·2390	128	0·1139
N *S*+	*NSN*, *NSNS*	39·9928	40	0·0000
N *S*−	*NN*	85·6983	84	0·0337
		579·9999	580	0·2370
				d.f. 2 $p = 0{\cdot}9$

It will be seen that the agreement between the calculated figures and those actually observed is very close indeed, and provides additional evidence of the correctness of the genetical interpretation of Sanger and Race.

The blood groups of the family are as follows:

Mrs. M.G.	Group *A* R^r (*cdE/cde*) *M S*− Lutheran − Lewis −
Mr. G.	Group *O* R_1R_2 (*CDe/cDE*) *MN S*+ Lutheran − Lewis −
C. G., son	Group *A Rh*+ *M S*+
Stillborn infant	Group *A Rh*+ Direct Coombs' Test +++

The anti-*S* titre of the serum rose from 1 : 1 three days before delivery to 1 : 16 three weeks after delivery, and by six weeks *post partum* had fallen to 1 : 8. The antibody was active at 37° C. and 20° C., though slightly more intense reactions were obtained at 37° C. The thermal range and the familial incompatibility of *S* groups suggest that this is an immune agglutinin, though the presence of the anti-*D* agglutinin (titre 1 : 16) does not allow of any evaluation of the part it may have played in fœtal morbidity. It is unlikely that the agglutinin has been previously encountered in this laboratory, as the donor of the *Rh* negative cells which were first found to be agglutinated by this serum has been one of the standard *Rh* negative controls for antibody investigations since 1943.

I should like to thank Dr. R. R. Race for his interest and advice, and Mr. J. A. Morton and Mr. W. Penfold for technical assistance.

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Variations in Spermatogenesis of Oligospermic Men

Zondek, Bromberg and Polishuk have suggested[1] that oligospermia in men can be divided into two types, constant and periodic; and that it is only men in the latter group who are likely to produce pregnancies. While agreeing that individuals differ in the range of variation of their sperm counts, we do not think this is either a clear-cut or a useful distinction.

It is, of course, impossible to draw conclusions about the reaction of a patient to treatment for oligospermia unless several specimens have been examined before treatment is given. It is also essential that specimens for comparison should have the length of the period of abstinence since the previous ejaculation controlled in both directions. Zondek *et al.* give only a minimum of length of interval. An interval of two or three weeks may result in sperm counts five times as high as those obtained after three to five days. As the number of motile spermatozoa does not increase with a long interval to anything like the same extent as does the total number of spermatozoa present, and as their viability is frequently impaired, the increase in sperm density cannot be regarded as improving the chances of fertilization. A possible cause of apparent periodic oligospermia is the occasional loss of the first few drops of the ejaculate, the majority of the spermatozoa being in the first fraction[2]. In our experience this is often the cause when men, whose sperm density is usually more than 60 million per c.c., produce specimens with counts less than 20 million.

Case	Sperm densities (M./c.c.)	Corresponding interval since previous ejaculate (days)
I	0·4, 1·0, 0·1, 0·2	3, 3, 3, 3
II	5, 3, 5, 4, 5, 10, 2, 5	3, 4, 3, 7, ?, 13
III	10, 6·5, 6·5	5, 4, 2
IV	8, 2	11, 3
V	6, 5, 17	2, 8
VI	1·5, 0·5	28+, 2
VII	1·5, 1·5, 1·0, 2·0, 0·65	?, 8, 4, ?, 4

It is not necessary to postulate periodic, as opposed to constant, oligospermia to explain pregnancies in wives of oligospermic men. The lower limits of sperm count usually stated as necessary for fertilization are definitely too high. In a series of more than seven hundred sub-fertile marriages, seven women whose husbands constantly had sperm densities less than 20 million per c.c. have conceived. Details are given in the accompanying table. In cases II–V conception took place shortly after the last semen analysis; in case I the last count was done a month after conception occurred. Cases VI and VII are less convincing, as conception did not take place until more than a year after the patients stopped attending the clinic, and the husbands may have improved in the interval. A further seven conceptions occurred in women whose husbands had, in a single seminal analysis, sperm densities less than 20 million per c.c.

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[1] *Nature*, **161**, 176 (1948).
[2] Macleod, S., and Hotchkiss, R. S., *J. Urol.*, **48**, 225 (1942).

Relation Between Fountain Pressure and Heat Current in Helium II

Allen and Reekie[1] directed attention to the fact that the fountain-pressure difference ΔP at the ends of a narrow slit or capillary produced by a temperature difference is, in the absence of mass flow, exactly proportional to the heat current W appearing simultaneously with the fountain pressure.

For very narrow slits (up to 10^{-4} cm.) the heat current is proportional to the temperature difference at all temperatures up to the immediate neighbourhood of the λ-point. For wider slits (greater than 10^{-3} cm.), the linear relation between heat current W and temperature difference ΔT changes gradually over to proportionality between W and the cube root of ΔT. These deviations from linearity are greater for wider slits, and for higher temperatures and greater gradients at any constant slit width.

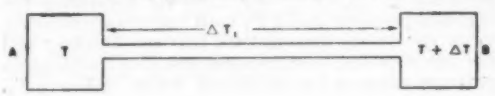
Keesom and Duyckearts[2] and Mellink[3] confirmed that the Allen – Reekie proportionality between fountain pressure ΔP and heat current W is retained no matter what the relation between W and ΔT, including the regions where this dependency approaches the cube root law.

This is difficult to understand so long as the factors responsible for the deviation from linearity between W and ΔT are regarded as operative in the slit itself where the fountain pressure gradient must exist.

A simple explanation can be given in terms similar to the model proposed recently[4] for the anomalous mechano-caloric effects in the super-critical mass flow of helium II through slits.

The experimental arrangement for measuring W and ΔP may be represented schematically as in the accompanying figure.

A narrow slit of from 0·1 to 20 μ, or a capillary filled with emery powder, connects two temperature



baths A and B containing bulk liquid at temperatures T and $T + \Delta T$ respectively.

The anomalous heat effects accompanying mass flow could be explained by the assumption that the temperature difference ΔT between A and B is greater than the temperature difference ΔT_1 between the ends of the slit itself, if the velocity of the particles emerging from the slit (or entering the slit) is greater than the critical velocity of the superfluid flow.

In the present problem there is no net mass flow. But according to L. Tisza and F. London[5], the heat flow in a narrow slit can be considered as a viscous back-flow of normal particles under the fountain-pressure difference. The velocity u of the normal (excited) particles can be estimated from the equation $W = \rho Q u$, where ρ is the density and Q the heat content of helium II. u is actually about equal to the critical velocity for values of W in the region where the first deviations occur from the linear relation between W and ΔT. These deviations from linearity may thus be due to the appearance of temperature differences $\Delta T_b = (\Delta T - \Delta T_1)$ in the bulk liquid near the ends of the slit, caused by the normal particles emerging from the slit at a velocity higher than the critical one.

The fountain pressure can only depend on the temperature difference ΔT_1 between the ends of the slit itself. For narrow slits it obeys the relation given by H. London[6],

$$\Delta P = \rho S \, \Delta T_1, \qquad (1)$$

and generally (see S. R. deGroot[7])

$$\Delta P = k_f \, \Delta T_1, \qquad (2)$$

where k_f falls to lower values than ρS for capillaries of such a width that some excited particles can also pass, and the heat of transportation Q^* is less than TS.

The heat current, on the other hand, depends on the total temperature difference $\Delta T = \Delta T_1 + \Delta T_b$; but the thermal resistance consists of two resistances in series, namely, the resistance in the bulk adjacent to the ends of the slit, and the resistance in the slit. It is assumed that W is proportional exactly to ΔT_1 within the slit in accordance with the model of viscous back-flow, and that all deviations from linearity are due to the resistance in the bulk liquid. From the fact that the heat flow in wide tubes is proportional to $(\Delta T)^{1/3}$, we may assume the same dependency to be valid for the resistance in the bulk liquid.

The condition for continuity of heat flow states that

$$W = k_1 \, \Delta T_1 = k_2 (\Delta T_b)^{1/3}, \qquad (3)$$

with

$$\Delta T = \Delta T_1 + \Delta T_b.$$

Comparing the first part of (3) with (2) yields exactly the Allen – Reekie relation

$$W/\Delta P = k_1/k_f = \text{constant}. \qquad (4)$$

This result holds no matter what the relative importance of the different series resistances, remaining true even when the heat current follows almost the cube root law. Thus for wider slits the fountain pressure may be very small because $\Delta T_1 \ll \Delta T$, so that $\Delta T \doteqdot \Delta T_b$ and W is almost exactly proportional to $(\Delta T)^{1/3}$; for narrower capillaries the fountain pressure and ΔT_1 both become appreciable, so we get values intermediate between linearity and the cube root law. For the narrowest slits the fountain pressure assumes its maximum value, $\Delta T = \Delta T_1$, $\Delta T_b = 0$, because the particles emerge from the slit at velocities smaller than the critical one and no temperature gradient appears outside the ends of the slit. So W is now exactly proportional to ΔT.

In consequence of this interpretation, the transition probability relation derived by us previously to account for the cube root law[8] can hold only in the bulk liquid, and not in very narrow slits or capillaries. The proximity of the wall apparently inhibits the relaxation effects, a circumstance which is probably related with the fact that the superfluidity of helium II appears near walls and in narrow slits.

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High-Frequency Resistance of Superconductors

MEASUREMENTS of the high-frequency resistance of superconducting tin, extending previous work[1] at 1,200 Mc./s., have now been carried out at frequencies around 9,200 Mc./s. (wave-length 3·2 cm.). The experimental technique is in principle the same as at 1,200 Mc./s., with the twin-wire resonator replaced by a half-wave coaxial resonator. The variation of the resistivity, R, with temperature is shown in the accompanying graph, together with the results of the earlier measurements for comparison. For convenience, R is expressed in terms of the resistivity, R_n, of normal tin just above the transition temperature. The experimental points plotted are those taken with one of the five specimens actually measured; the points for the other specimens are in close agreement.

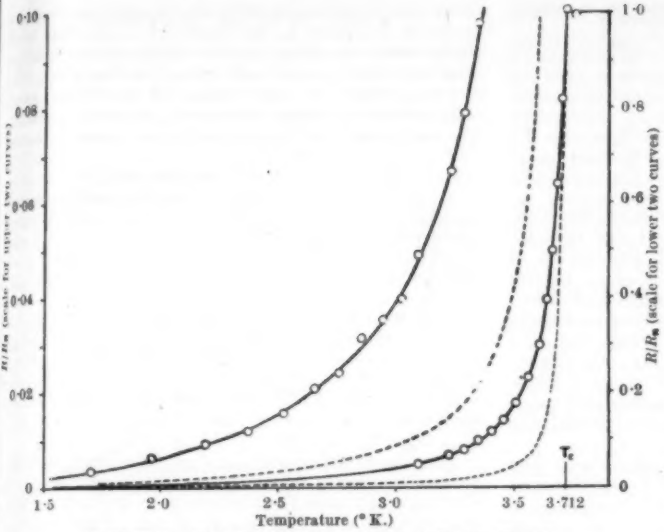
If the usual assumption[2] be made that a superconductor contains both 'superconducting' and 'normal' electrons, which react independently to an applied field, certain predictions about the frequency-variation of r $(= R/R_n)$ may be made by means of general arguments. In the first place, it may be shown that the initial slope dr/dT, just below the transition temperature, T_c, should vary with frequency as $\nu^{-2/3}$. The experimental results are not in agreement with this prediction. For the two frequencies used, the ratio of the slopes is 2·95 instead of the predicted 3·9.

It may further be shown that at temperatures sufficiently far below T_c that $r \ll 1$, the resistivity R at a given temperature should vary as ν^2. A separate experiment has shown that $R_n \propto \nu^{2/3}$, in accordance with the theory of the anomalous skin effect[3], so that it would be expected that $r \propto \nu^{4/3}$ at any temperature well below T_c. It may therefore be predicted without any but general arguments based on the model that, for $r \ll 1$,

$$r = Af(T), \qquad (1)$$

where

$$A \propto \nu^{4/3}. \qquad (2)$$



RESISTIVITY OF SUPERCONDUCTING TIN: FULL LINES, AT 9,200 Mc./s.; BROKEN LINE, AT 1200 Mc./s. THE UPPER CURVES ARE ON TEN TIMES THE SCALE OF THE LOWER CURVES

Now it has been found empirically that for $T < 3{\cdot}3°$ K. the experimental curves for both frequencies, in agreement with equation (1), are closely fitted by the expression

$$r = A' \cdot \frac{t^4(1-t^2)}{(1-t^4)^2},$$

in which t is the reduced temperature T/T_c.

The experimental values of A', however, show a marked departure from the frequency-variation of equation (2). Thus, $A' = 0{\cdot}0195$ at 1,200 Mc./s., and 0·0865 at 9,200 Mc./s.

The ratio of these two values, 4·43, is very different from the predicted ratio of 15·12. A discrepancy of this magnitude cannot be accounted for by observational errors, and it must be concluded either that some relevant factor has been omitted from the general arguments, or that an incorrect model has been used. Further experiments are in progress to discover the cause of these anomalies, and the measurements are also being extended to mercury, which appears from preliminary results to exhibit similar anomalies, though to a lesser extent.

A full account of this investigation will be published elsewhere.

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Oxidation of Uranium Dioxide (UO_2)

IN connexion with earlier investigations on uranium oxides in this Institute, it was observed that uranium dioxide (UO_2) can react with oxygen at so low a temperature as 120° C. To obtain more exact information about this low-temperature oxidation of UO_2, the oxide was heated in purified oxygen at different temperatures from 100° to 265° C. and the reaction products examined by the X-ray powder method[1].

At 150° C., UO_2 takes up oxygen at least to the composition $UO_{2\cdot34}$. This oxidation causes a displacement of the X-ray interference fringes and a broadening of some of them, indicating a change to lower symmetry. As an approximation the lattice of the new structure was considered to be cubic. A specimen with the composition $UO_{2\cdot34}$ was found to have the lattice constant $a = 5{\cdot}40$ kX. (for UO_2, $a = 5{\cdot}468$ kX.). It is difficult to decide whether or not the structure of UO_2, the β-phase, changes continuously as the oxygen content increases. If the change is discontinuous, the two structures belong to different phases.

The experimentally found density of UO_2 is 10·80 gm./c.c. and of $UO_{2\cdot34}$ 11·05 gm./c.c. The increase of the density from UO_2 to $UO_{2\cdot34}$ can only be explained by the assumption that oxygen, at least partly, enters into interstitial positions of the UO_2 lattice. Nevertheless, the lattice contracts; this must be due to the fact that the expected increase of lattice dimensions due to interstitial addition of oxygen is overcompensated as some of the uranium ions change their charge from + 4 to + 6 (or + 5).

By raising the temperature to 200°–250° C. the oxygen content exceeds the formula $UO_{2\cdot34}$, and another new phase, the δ-phase, is formed. X-ray photographs indicate that the δ-phase has a narrow range of homogeneity around $UO_{2\cdot40}$. The phase is found to be tetragonal, a specimen with the composition $UO_{2\cdot43}$ having the following lattice constants: $a = 5{\cdot}37$ kX., $c = 5{\cdot}54$ kX. and $c/a = 1{\cdot}03$.

TABLE 1. CALCULATED DENSITIES OF THE δ-PHASE

Phase	Formula	Density in gm./c.c.
AB_2-addition	$UO_{2\cdot43}$	11·46
AB_2-substitution	$U_{0\cdot88}O_{2\cdot12}$	10·04
AB_2-subtraction	$U_{0\cdot81}O_2$	9·44

Table 1 gives the densities calculated for a preparation with the composition $UO_{2\cdot43}$ if the lattice is derived from that of UO_2 by: (1) addition of oxygen; (2) substitution of uranium with oxygen; or (3) subtraction of uranium. On comparing these densities with the observed one, 10·00 gm./c.c., only assumption (2) provides agreement between observed and calculated values. The lattice of the δ-phase must then be regarded as derived from that of UO_2 by substitution of uranium with oxygen. The formula of the specimen $UO_{2\cdot43}$ must therefore strictly be written $U_{0\cdot88}O_{2\cdot12}$.

The intensities of the X-ray interference fringes indicate that the uranium atoms form a face-centred lattice (000; 0; $\frac{1}{2}\frac{1}{2}0$; $\frac{1}{2}0\frac{1}{2}$). In Table 2 intensities are calculated for the uranium atoms in the usual way, including corrections for absorption, but without temperature factor. Observed and calculated intensities are in good accord.

TABLE 2. OBSERVED AND CALCULATED INTENSITIES ON POWDER PHOTOGRAPH OF $UO_{2\cdot44}$. IRON K RADIATION

$h\,k\,l$	$I_{obs.}$	$I_{calc.}$	$h\,k\,l$	$I_{obs.}$	$I_{calc.}$
111	st.	5·2	313	st.	5·9
002	w.	1·0	331	m.	3·0
200	m.	2·0	204	st.	3·1
202	st.	3·1	402		3·1
220	w.	1·5	420		3·2
113	m.	2·6	224	m.	4·0
311	st.	5·2	422	v.st.	8·7
222	m.	2·6	115	m.	5·4
004	v.w.	0·7	333	st.	6·4
400	v.w.	1·3	511	v.st.	14·0

The existence of a uranium oxide with the composition U_2O_5 has often been assumed, and recently by R. Lydén[1], who prepared it by the action of potassium hydrogen carbonate on U_3O_8. In the tensimetric phase diagram of W. Biltz and H. Müller[3], an oxide U_2O_5 had no observable range of existence. In our investigations, however, a phase near the composition U_2O_5 was found; but the oxide exists only at temperatures below 260–270° C. as a tetragonal deformed substitutional UO_2 phase and has a composition which does not seem to exceed the formula $U_{0\cdot 88}\ O_{2\cdot 12}$.

X-ray photographs of products prepared according to Lydén exhibit a slightly modified U_3O_8-structure. The products were found to have a composition in the region of $UO_{2\cdot 66}$ although approximately a third of the uranium had gone into solution. By reduction of U_3O_8 with hydrogen at 330° C., similar X-ray photographs were obtained, indicating that U_3O_8 has a range of homogeneity between $UO_{2\cdot 67}$ and $UO_{2\cdot 56}$.

P. Jolibois[4] has recently published results on the oxidation of UO_2 which also show the existence of a phase with a composition close to U_2O_7 ($UO_{2\cdot 33}$) but without giving further information on the properties of this phase.

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Crystal Structure of Uranium Oxide (U_3O_8)

THE uranium oxide U_3O_8 can be obtained by heating UO_2 as well as UO_3 in air or oxygen to red heat. So far as we know, however, no determination of the structure of this oxide has been published; the difficulty in preparing single crystals of U_3O_8 may be the reason.

While preparing UO_3 crystals, F. W. Hillebrand[1] got some small green-olive-greyish crystals. They seemed to be orthorhombic and were perhaps U_3O_8 crystals. V. M. Goldschmidt and L. Thomassen[2] reported that U_3O_8 did not crystallize regularly.

We did not succeed in preparing U_3O_8 single crystals; but one of the preparations gave X-ray photographs on which reflexions with indices $00l$ only were sharp and well defined, and this has enabled us to put forward a hypothetical crystal structure. All lines on the X-ray photographs can be identified as belonging to an orthorhombic cell with the dimensions: $a = 6{\cdot}703$ kX., $b = 3{\cdot}969$ kX., and $c = 4{\cdot}136$ kX.

The density of U_3O_8 was found pycnometrically to be 8·34 gm./c.c. On comparing this density with those calculated under different possible assumptions as given in Table 1, one finds for U_3O_8 that with three uranium atoms in the elementary cell the density is not in agreement with that observed. The observed density is only compatible with U_3O_8 as an AB_2 subtractive phase (or an AB_2 interstitial phase). The elementary cell then contains two uranium atoms.

TABLE 1. CALCULATED DENSITIES OF U_3O_8

Phase	Formula	Mol.	Density in gm./c.c.
A_2B_3	U_3O_8	1	12·63
AB_3-addition	$U_{1\cdot 13}\ O_3$	2	9·46
AB_3-substitution	$U_{1\cdot 33}\ O_{3\cdot 01}$	2	9·18
AB_2-subtraction / AB_2-addition	$UO_{2\cdot 67}$	2	8·42
AB_2-substitution	$U_{0\cdot 81}\ O_{2\cdot 13}$	2	6·88

Here we will not give a general discussion of the space groups which can be considered, but only state that the intensities of the lines on the X-ray photographs indicate the uranium atoms to have the positions a: 000, b: $\frac{1}{2}\frac{1}{2}0$. The arrangement of the atoms may then be referred to the space-groups D_{2h}^{19}, D_{2h}^{23}, D_{2h}^{9}, D_{2h}^{7}, D_{2h}^{8}, D_{2h}^{4}, D_{2h}^{3}, D_{2}^{8}, C_{2v}^{14}, C_{2v}^{11}, C_{2v}^{6}, C_{2v}^{5}, C_{2v}^{2}.

The observed intensities were estimated visually. Intensities were calculated in the usual way, including corrections for absorption in the powder rod, but without the temperature factor. The structure factor was calculated for the uranium atoms only. As seen from Table 2, observed and calculated intensities are in good agreement.

TABLE 2. OBSERVED AND CALCULATED INTENSITIES ON POWDER PHOTOGRAPH OF U_3O_8. IRON K RADIATION

$h\,k\,l$	$I_{obs.}$	$I_{calc.}$	$h\,k\,l$	$I_{obs.}$	$I_{calc.}$
001	m.	2·1	402	m.	1·8
110	m.	3·3	130		1·8
200	w.	1·6	420		1·8
111	m.	5·4	113	st.	3·7
201	w.	2·7	203		1·8
002	w.	1·1	510	w.	1·8
020	w.	1·0	131	m.	3·9
310*	m.	2·1	421	w.	3·9
021	w.	1·9	511*	m.	4·0
112	v.st.	3·6	330	w.	2·5
311		3·6	023	w.	2·6
202		1·8	313	m.	5·2
220	w.	1·7	600	v.w.	1·3
400	v.w.	0·9	132	st.	5·6
221	m.	3·4	331		5·6
401	v.w.	1·7	422	m.	6·0
022	w.	1·6	512	m.	6·1
312	m.	3·2	601		3·0
003	v.w.	0·9	223	m.	6·7
222	m.	3·5	403	w.	3·5
			004[1]	m.	2·3

* Coincides with β-reflexions.

Oxygen ions scatter X-rays so slightly that with visually observed intensities we cannot draw conclusions regarding their positions. It is probable, however, that the U_3O_8 structure is related to the ReO_3 structure, but with deformed UO_6^{-6} octahedrons with anion vacancies. If the distribution of these vacancies is statistical, the cell already mentioned can be considered as the elementary cell, or else it would be larger. The ReO_3 structure type is, according to K. Meisel[4], the highly symmetrical form of an AB_3 structure, with which the CrO_3, MoO_3 and the WO_3 structures[5] are also closely related.

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Structure of Abraded Surfaces

THE importance of surface conditions in the fatigue of metals and alloys has led to an investigation in this Laboratory into the effect of abrasion on the hardness and microstructure of surface and sub-surface layers.

Hardness measurements were made with a 'Tukon' microhardness tester and a load of 25 gm. on metallographically polished 2° taper sections prepared in a manner described by Nelson[1], and more recently by Moore[2], except that the bulk of the metal was used as a backing for the hardness impressions instead of thin wedges. The mechanical magnification obtained was of the order of 20, thus allowing hardness impressions to be spaced at effective distances of 0·5 μ below the surface.

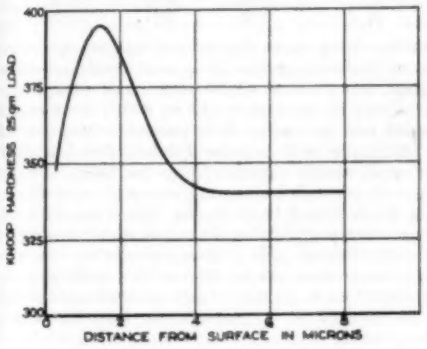

Fig. 1

In the case of chromium-molybdenum steel, heat-treated to a uniform sorbitic structure and to an average bulk hardness of Knoop 340, it was found that abrasion caused an increase in hardness in the surface layers to a depth of 3·5–6 μ according to the degree of abrasion. The maximum hardness obtained was approximately constant at Knoop 400 and occurred at a depth of 1·5 μ in all cases (Fig. 1). However, the most notable feature of the curves of hardness against depth was the fact that the hardness increase diminished progressively from a depth of 1·5 μ to the surface.

Metallographic examination of the taper sections at high magnifications (× 2,500) revealed a layer, corresponding in thickness to the depth of 'softening', in which a modification of the original structure of the steel was evident. Similar structural changes have been observed by Wulff[3] and his associates, in stainless steel, and by Benard, Lacombe, and Chaudron[4], in 'Armco' iron, and have been explained as being due, principally, to the plastic deformation accompanying abrasion. However, the 'softening' effect in the surface layers of steel specimens used in this investigation indicated that plastic deformation cannot be responsible for all the effects observed. The probable cause for this 'softening' was tempering or recrystallization due to the frictional heat of the abrading process, since decarburization of the surface was proved to be absent, and structural alteration during the polishing of the sections was overcome by using a polish-etch technique.

To obtain further information on this point, a series of severely abraded alpha-brass samples (containing 35 per cent zinc) were sectioned after various annealing treatments at temperatures up to 350° C. In the unannealed specimen, the hardness curves were of the same form as previously described, while metallographic examination revealed a layer of fine crystallites at the surface extending to a depth of 1–2 μ (Fig. 2), followed by a deformed layer to a depth of 35 μ. The crystallites were resolved at a magnification of 2,500, the average size being 0·5–1 μ (Fig. 3). No change from the above microstructure was observed in specimens annealed up to 240° C., but annealing at 249° C. caused an increase in the depth of the layer of fine crystallites, indicating that recrystallization of the deformed sub-surface layers had commenced (Fig. 4).

The similarity between the structure obtained by recrystallization of the deformed layers on annealing, and that existing in the extreme surface layer of the unannealed specimen, indicated that the 'softening' observed was due to recrystallization during abrasion. Annealing at still higher temperatures produced considerable grain-growth in the already recrystallized zones and progressive recrystallization into the more lightly deformed regions.

It is concluded from these experiments that, during abrasion, the temperature of the extreme surface layers is raised sufficiently to cause recrystallization. It has further been shown that recrystallization in an alpha-brass, containing 35 per cent zinc, when deformed as in abrasion, occurs at a temperature of 249° C. with the formation of crystallites of approximately 10^{-4} cm.

These results are important in relation to the failure of metals by fatigue. Since fatigue cracks normally start at the surface, the recrystallized and deformed layers produced by surface grinding should be removed before testing, to ensure that endurance curves characteristic of the material are obtained.

Fig. 2

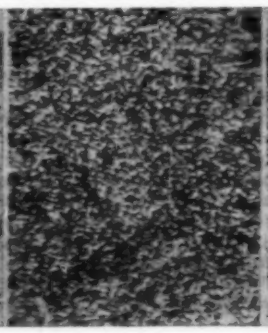

Fig. 3

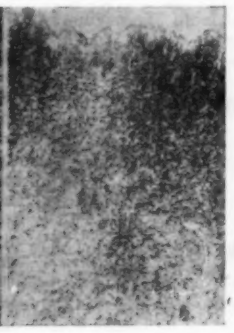

Fig. 4

Fig. 2. STRUCTURE OF UNANNEALED BRASS SPECIMEN. × 150

Fig. 3. STRUCTURE OF SURFACE LAYER. × 1,500

Fig. 4. STRUCTURE OF ANNEALED BRASS SPECIMEN. × 150

The work described above was carried out as part of the programme of the Metallurgy Section, Division of Aeronautics, Council for Scientific and Industrial Research.

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[2] Moore, A. J. W., C.S.I.R. Lubrication and Friction Report No. 44 (unpublished).
[3] Wulff, John, *Trans. Amer. Inst. Mech. Eng.*, Iron and Steel Division, 295 (1941).
[4] Benard, J., Lacombe, S. P., and Chaudron, G., "Journées des Etats de Surface" (Paris, October 1945).

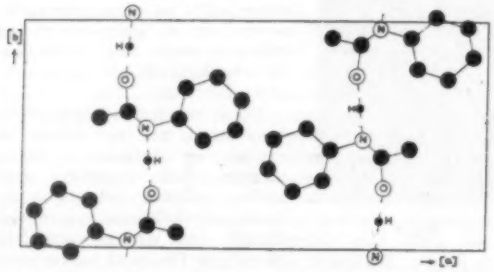
Crystal Structure of Acetanilide: Use of Polarized Infra-Red Radiation

The crystal structure of acetanilide has been determined[1] by classical X-ray diffraction methods, making use of information derived from polarized infra-red radiation technique as a time-saver in the trial-and-error process. The crystals from water or ethanol vary in form from plates {100} to truncated bipyramids {111}, but growth from the molten state results in acicular crystals, elongated along [*b*] and tabular on (100). The orthorhombic unit cell contains eight molecules and has dimensions:

$[a] = 19{\cdot}50$, $[b] = 9{\cdot}46$ and $[c] = 7{\cdot}96$ A.; space group $Pbca - D_{2h}^{15}$.

Utilizing available data regarding cleavage and optical properties[2], a three-dimensional molecular model was constructed which was expected to represent the most probable arrangement within the unit cell, and which would normally have been used as a starting-point for preliminary trial-and-error calculations of structure amplitudes. Simultaneously, experiments with polarized infra-red radiation were being conducted by Crooks[3] which yielded information concerning the directions of the C_6H_5—N, N—H, C=O and C—CH_3 bonds, as well as indicating the relative orientations of the benzene rings. The rough molecular model was adjusted slightly to take these new data into account, and from the measured atomic parameters, the first thirty or forty structure amplitudes calculated showed remarkably good agreement with the experimental values.

X-ray intensities were obtained from Weissenberg photographs taken about the zero-levels of the [*b*]- and [*c*]-axes, and from single-crystal oscillation photographs about the [*c*]-axis. Refinement of the structure was effected by means of Fourier projections on (010) and (001) and by means of appropriate lines and sections of a three-dimensional synthesis, with the result that the phases of about three hundred structure amplitudes are now known with certainty. The structure is depicted in the accompanying diagram; bond-lengths appear to be within the accepted values; the length of the hydrogen bond distance N—H—O is $2{\cdot}9 \pm 0{\cdot}1$ A. It is hoped that further refinement will be carried out later; but since this is by no means certain, the following list of co-ordinates is here placed on record.



Arrangement of molecules in unit cell between $z = 0$ and $z = 1/2$. The other four molecules in the cell may be obtained by reflecting these four across the plane $y = 1/4$ and gliding them $c/2$

	X	*Y*	*Z*
C_1	0·16	0·07	0·12
C_2	0·11	0·98	0·17
C_3	0·04	0·02	0·14
C_4	0·03	0·16	0·06
C_5	0·08	0·25	0·01
C_6	0·15	0·21	0·04
N	0·23	0·03	0·15
C_7	0·27	0·10	0·25
O	0·28	0·24	0·30
C_8	0·33	0·07	0·29

The use of polarized infra-red radiation promises to be of great assistance in crystal structure determinations, but further trials with more complex substances will be necessary before a full assessment of its value can be made. It is probable that the infra-red technique will require further development so that small single crystals may be used. In some work with crystals containing water of crystallization it has been found that strong water-bands tend to obscure that part of the spectrum which would yield most information, but it is expected that more complete polarization would enable this difficulty to be overcome. In a crystal where several similar bonds are distributed in different directions, it may not prove possible to analyse the results adequately without a considerable increase in sensitivity of the infra-red apparatus.

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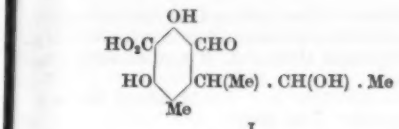
March 22.

[1] Report of Institute of Physics X-Ray Analysis Conference, 1947. *J. Sci. Instr.*, **25**, 90 (1948).
[2] Winchell, A. N., "Optical Properties of Organic Compounds" (Wisconsin, 1943).
[3] Crooks, D. A., *Nature*, **160**, 17 (1947).

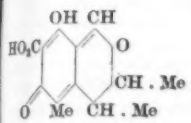
Structure of Citrinin

In view of the recent communication on this topic by Cram[1] to the editor of the *Journal of the American Chemical Society*, we wish to record that in the course of an extensive investigation on the chemistry of citrinin initiated in these laboratories in 1945, the synthesis of 4-methyl-5-ethylresorcinol[2], m.p. of anhydrous material 94–95°, was effected in 1946, and the orientations of the two isomeric phenols '*A*' and '*B*' $C_{11}H_{14}O_2$ afterwards established. From these results, *inter alia*, together with a study of the degradation products of methylated citrinin and of dihydrocitrinin and its ether, evidence has accumulated which leads to the conclusion that citrinin in all probability is best represented by the expression (II).

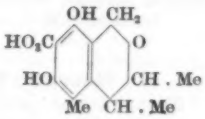
The claims of competing structures, including those of the quinol (*cyclo*hexadienolone) type, have been considered; but so far as our evidence goes it would seem that formula (II), which is an anhydro



I



II



III

form of (I), most satisfactorily explains (*a*) the ready aromatization of the compound in warm acid or alkaline media with the extrusion of formyl (as formic acid) and carboxyl (as carbon dioxide) groups; (*b*) the formation of formic acid and not formaldehyde or glyoxylic acid on the ozonolysis of citrinin and its ester; and (*c*) the formation of a stable dihydro derivative (III) with simultaneous aromatization. The structure (III) ascribed to the latter compound is in agreement with its blue ferric reaction, which is characteristic of γ-resorcylic acids. On the basis of formula (II), the phytochemical formation of citrinin may conceivably proceed by way of the intermediate (I).

It would seem that the claim by Cram[1], that the isolation of authentic 4-methyl-5-ethylresorcinol from citrinin completely eliminates the formula proposed for the latter by Robinson *et al.*[2], can scarcely be sustained at present. The above formula retains the original suggestion of a hemi-quinone type of kernel.

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A. Robertson
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[1] Cram, *J. Amer. Chem. Soc.*, **70**, 440 (1948).
[2] Compare Brown, M.Sc. Thesis, May 1947, University of Liverpool.
[3] Robinson *et al.*, *Phil. Trans. Roy. Soc.*, B, **220**, 297 (1931).

Nitration of Simple Heterocycles

In a recent letter in *Nature*[1], Schofield and Swain comment, *inter alia*, upon the failure of resonance theory to explain non-nitration of *iso*quinoline in position 7: the following results may be of interest.

In the course of work in these laboratories we have been led to investigate the nitration products of 3:4-dihydro*iso*quinoline derivatives and have found, for example, that 1-*p*-nitrophenyl-3:4-dihydro*iso*quinoline gives an 80 per cent yield of the 7-nitro derivative, this structure being proved by comparison with the product of cyclization of *N*-*p*-nitrobenzoyl-2-(4′-nitrophenyl)ethylamine. On the other hand, 1-*p*-nitrophenyl*iso*quinoline yields 85 per cent of 1-*p*-nitrophenyl-5-nitro*iso*quinoline, identified by conversion to 1-*p*-chlorphenyl-5-chlor-*iso*quinoline and comparison with a synthetic sample. Such substitution in the *iso*quinoline ring may be compared with that of quinoline which is nitrated in the 5 and 8 positions, whereas tetrahydroquinoline has been shown to nitrate in position 7 [2], a result compatible with expectation since *o*-toluidine yields 4-nitro-2-aminotoluene[3]. Similarly, *iso*quinoline is nitrated principally in the 5 position with a small proportion of the 8-isomer[4]. Nitration of reduced *iso*quinoline has escaped attention, and investigation of the products of nitration of 3:4-dihydro- and 1:2:3:4-tetrahydro*iso*quinoline is now being undertaken, when we expect to isolate the 7-nitro derivatives in accordance with the above result and by comparison with the nitration of *o*-cyantoluene, which yields 4-nitro-2-cyantoluene[5], and of 2-phenylethylamine, which has been shown to give 45 per cent of the para and 18 per cent of the meta isomer[6]. Results will be reported in detail elsewhere.

We wish to thank the directors of May and Baker, Ltd., for permission to publish these results.

David W. Mathieson
A. McCoubrey

Research Laboratories,
May and Baker, Ltd.,
Dagenham, Essex. May 5.

[1] *Nature*, **161**, 690 (1948).
[2] Hoffmann and Königs, *Ber.*, **16**, 736 (1883). v. Braun, Grabowski and Rawicz, *Ber.*, **46**, 3173 (1913).
[3] Noelting and Collin, *Ber.*, **17**, 265, 268 (1884).
[4] Andersag, *Chem. Zentr.*, **1**, 3595 (1934).
[5] Landsberger, *Ber.*, **31**, 2880 (1898).
[6] Ehrlich and Pistschimuka, *Ber.*, **45**, 2431 (1912).

Production of Quinolyl and Pyridyl Anions during Decarboxylation

It has been shown[1,2] that when picolinic and quinaldinic acids are decarboxylated in the presence of aldehydes and ketones, α-pyridyl and α-quinolyl carbinols of the type Py(Qy).CH(OH).*R* are produced in good yields (40–80 per cent). The course of this reaction has been formulated in terms of the intermediate formation of α-pyridyl and α-quinolyl anions, which are formally of cyanide ion type[1,2]. The possibility that the cyanide function might by conjugation be extended to the γ-position has been confirmed recently by Mislow[3], who has obtained γ-pyridyl diphenylcarbinol by the decarboxylation of *iso*nicotinic acid in benzophenone. We now report that we have prepared γ-quinolyl diphenylcarbinol, m.p. 247°, from cinchoninic acid and benzophenone in yields of 7–10 per cent; we are developing the reaction as a possible route to quinine analogues.

We also find that, in the presence of decarboxylating quinaldinic and picolinic acids, it is possible to exchange the alkoxy groups of esters for pyridyl and quinolyl groups and to effect substitution by these groups at cationoid (electrophilic) centres in aromatic molecules; we take this to confirm our view that quinolyl and pyridyl anions are produced during the decarboxylation process.

B. R. Brown
D. Ll. Hammick
B. H. Thewlis

Dyson Perrins Laboratory,
University, Oxford. April 15.

[1] Dyson and Hammick, *J. Chem. Soc.*, 1724 (1937).
[2] Ashworth, Daffern and Hammick, *J. Chem. Soc.*, 809 (1939).
[3] *J. Amer. Chem. Soc.*, **69**, 2559 (1947).

Ecology of Sponges

The statement has often been made that sponges can be found growing almost up to high-tide mark. As a result of close observation over miles of shore in a dozen different localities on the south and west coasts of Britain during the past twelve months, I have no hesitation in saying that only exceptionally are sponges found above mid-tide level. Even then, the most to be seen are a few undersized specimens of *Hymeniacidon perlevis* (= *H. sanguinea* Auctt.) in

damp sheltered crevices protected from swirl and direct sunlight; and these are no more than a foot above mid-tide.

The second current statement proved to be false is that sponges are capable of surviving considerable desiccation. Careful observation shows that rarely are they found growing where there is no drip, or where they are not overhung with seaweed. I have found a few specimens of *H. perlevis* exposed to the strong rays of a spring sun. After exposure of two hours or more, between the ebb and flow of the tide, they have appeared dry and the surface shrivelled. The following day they have appeared completely regenerated. By marking such specimens and inspecting them at intervals, the following sequel has been established. They can appear regenerated after several such exposures; but in due course they disintegrate by stages, and after a month, instead of a sponge 50 mm. square, there are found a few small growths each about 5 mm. across. In two to three months time, depending on the amount of sunshine, even these feeble residues are gone.

The third, oft-repeated, fallacy is that sponges have no enemies apart from the nudibranchs that feed on them. I have often found *Patella*, *Littorina littorea* and *L. obtusata* on sponges, and have found their stomachs to contain spicules. At least two other gastropods are suspect. *L. obtusata* feeds more particularly on *Grantia compressa* and can often be found on it with its mouth closely fixed on the rim of a large hole in the wall of the sponge. There is sufficient circumstantial evidence for the view that these holes, commonly found in the sides of *Grantia*, are entirely the work of *Littorina obtusata*.

The fourth fallacy is that *Halichondria panicea* is the sponge most commonly found on the shore. *Hymeniacidon perlevis* grows higher up the beach and is more abundant; but because it is usually tan, or a dull brick-red, as against the conspicuous green or yellow of *Halichondria*, it is less readily seen. In some places it is a hundred times more plentiful, bulk for bulk, often twenty times, and, at a rough but conservative estimate for all British coasts, not less than ten times as plentiful. This last low average allows for any occasional restricted areas there may be where *Halichondria* is as abundant, or slightly more abundant, than *Hymeniacidon*, and of which I have not had experience.

Finally, there is clear evidence of a zoning of sponges. From mid-tide level there is usually (in my experience, always) a zone of *Hymeniacidon perlevis*. This gives place, at a depth varying with local circumstances, to a mixed *Hymeniacidon perlevis–Halichondria panicea* zone, extending approximately to the shallowest low-water neaps. In this zone, but of sporadic occurrence, may be found *Sycon ciliatum*, *Leucosolenia coriacea* and *L. complicata*. The next zone contains predominantly *Grantia compressa*, with scattered *Hymeniacidon*, *Halichondria*, *Sycon*, and the two species of *Leucosolenia*, rarely anything else. The *Grantia* zone is bounded roughly by the shallowest and deepest low-water neaps. In the last zone, of the low-water springs, we find the richest crop. Here thirty or more species may occur, including those already mentioned for the first three zones.

This zoning, although like all zoning it is not absolutely invariable, is sufficiently consistent to serve as a working guide. To the experienced eye it is a good enough (the word infallible might almost be used) index to the state of the tide.

The fallacious ideas referred to above may individually seem unimportant; but in any study of the ecology of sponges they can, if not corrected, lead badly astray.

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Neurotic Behaviour in Ants

WHILE investigating ant learning with maze apparatus, behaviour was observed in one individual which is similar to that described by Cook[1] and Maier[2] as psychopathic or 'neurotic' behaviour in rats. What are thought to have been early symptoms of similar behaviour were later observed in a virgin female of the same colony of *Formica fusca* Latr.

The particular worker ant concerned was one of several which had already several times successfully completed this maze. On completion of the run, the ants were normally picked up in the experimenter's fingers (an act to which they were habituated and against which they did not struggle) and returned to the observation nest in which they were kept; that is, in effect, to their fellow-workers and a female which was at that time laying eggs.

On this occasion the worker ant had already successfully run the maze almost immediately after being placed in the starting chamber, making few errors and quickly correcting those which it did make. It was then placed back in the nest; but about five minutes later was once more taken from the nest and replaced in the starting chamber. It at once exhibited slight jerking movements of the legs and antennæ, but soon commenced to run the maze, moving very quickly and without error or returning, until halfway through, when it missed one of the solution-turns and followed an error-path until it reached its blank end. At first it made no movement back along the error-path, but with rising physical excitement and an increasing jerking of the limbs and antennæ constantly touched the three glass sides of the maze in the immediate vicinity of the blank end. After about a minute it returned along the error-path until near its commencement, where for a few seconds it remained standing while exhibiting constant and increasing limb and antennæ jerking. It then turned until facing down the error-path, and still jerking moved with a staggering motion backwards (the limb-jerking, which appeared to be completely out of its control, made ordinary movement a matter of difficulty) and almost at once commenced to circle, still backing, in a small area of the intersection of the tracks. The rapidity of the circling increased and the jerking became even more pronounced, and a few seconds later the ant was rescued, since it was, for other reasons, of experimental value. It was quiescent while held firmly in the experimenter's fingers, but was placed under a tap of cold running water for about ten seconds before being returned to the nest. In the nest it still exhibited slight tremors of the legs and antennæ, but soon ran about normally. On the next day the ant ran the maze successfully with some errors, but no sign of its earlier behaviour. On one following occasion, however, it showed pronounced jerking movements of limbs and antennæ after making the same error, and commenced trying to clean itself. It was, however, at once rescued and returned to the nest. This particular individual is one of the most active workers

of that particular colony, and also proved to be among the three workers of the colony (which consisted of 23 workers and two females) which were most successful at maze-learning.

A virgin female which was originally taken from the same colony but which had been isolated for nearly two months exhibited similar marked jerking movements of antennæ and legs on being placed in a strange plaster nest (she had previously been in a glass one containing earth). These movements soon stopped, however, when another virgin female was placed in the nest with her about one minute later.

I know of no previous records or accounts of similar behaviour in ants.

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[1] Cook, S. W., *Psychosom. Med.*, **1**, 293 (1939).
[2] Maier, N. R. F., "Studies of Abnormal Behaviour in the Rat" (New York: Harpers, 1939).

Distribution of Lugworms

ON the muddy sand of the Whitstable flats the casts made by the large population of *Arenicola marina* L. do not appear to be distributed in random manner at all times of the year. During the summer months there are straight lines, a foot or two wide, along which the casts, and very probably the worms, are more numerous than they are on the adjacent parts of the shore. There is no mistaking these lines, which appear clearly in photographs of the shore. They may be a hundred yards long and are apparently arranged in all directions, being neither all parallel with, nor all at right angles to, high or low tide marks.

We have been unable satisfactorily to account for this grouping; but a few preliminary tests suggest that the layer of soil worked by the worms and which overlies the clay substratum is deeper along the lines than on either side of them. We have not yet been able to discover what is the cause of the difference in soil depth.

We should be very interested to hear if this grouping phenomenon has been noticed on other *Arenicola* shores and we should be grateful if anyone who has observed it would write to us, especially if he has any explanation to offer.

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Life-History of *Splachnidium rugosum*

THE peculiar brown alga, *Splachnidium rugosum*, has been a subject for investigation on a number of occasions. Early workers considered that it should be classed with either the Laminariales or the Fucales. In 1920, Skottsberg[1] pointed out that the resemblances to those orders were more apparent than real and that its proper position should be near to the Chordariaceæ. Skottsberg went on to suggest that there should be a sexual generation, as he considered the commonly known plant to be asexual, reproducing by zoospores from sporangia borne in the conceptacles.

I have spent some time investigating the life-history of this alga, and I can now confirm Skottsberg's suggestions. The sporangia, which are unilocular, give rise to numerous swarmers which do not fuse and must therefore be zoospores. These swarmers settle down and germinate to give a dwarf, microscopic, branched, filamentous thallus so characteristic of many members of the Ectocarpales and allied orders. This thallus, which is presumably the gametophyte, has been maintained in culture now for more than a year: so far, however, no gametangia have been produced.

The account will be published later in full elsewhere. I wish to express thanks to Prof. V. J. Chapman for his advice during the course of this investigation.

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Botany Department, University College,
Auckland, New Zealand.
April 20.

[1] Skottsberg, C., *Svensk. Bot. Tid.* (1920).

A Method of Distinguishing between Young and Old Colorado Beetles

PREVIOUS records do not appear to give any indication of how to distinguish between young and old Colorado beetles, except during the first few days following the emergence of the young beetle. I have found evidence that it is possible to separate young and old beetles for a period of at least fourteen days after the emergence of the young adult by means of colour changes in the membranous wings. This fact is of considerable practical importance and assistance to entomologists, especially in countries where the beetle has not yet become an endemic pest.

Trouvelot states (private communication, 1946) that it is only possible to distinguish between young and old beetles for several days after emergence, (1) by the fact that the chitinous integuments remain soft for the first two to three days, after which they become hard like those of the mature beetle, and (2) by the fact that the yellow colour of the elytra takes several days to reach that bright hue so characteristic of the mature adult.

In looking for a more satisfactory method whereby young and old beetles could be separated for a longer period of time, I found the colour difference between the membranous wings of the freshly emerged and mature beetles was very marked, and appeared to remain distinguishable, although to a decreasing extent, for approximately fourteen days.

The membranous wings of the fresh emergent are transparent and devoid of colour, while those of the mature beetle are red except for the apex and anal border of the wing. The wings remain colourless for at least four to five days after emergence, and afterwards develop a pink colour which gradually deepens and diffuses over the greater part of the wing surface, especially along either side of the nervures, until the pink colour has given place to a distinct red hue. On an average it takes fourteen to twenty days for the colour intensity to equal that of the mature beetle. This colour change is probably due to the carotene absorbed by the beetle when it commences to feed. Therefore the period taken for the wing to reach the maximum colour intensity will vary within certain limits, according to the temperature and intensity of feeding.

It is hoped to publish fuller details of these findings at some future date.

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GOLGI APPARATUS OF LIVING HUMAN TESTICULAR CELLS SEEN WITH PHASE-CONTRAST MICROSCOPY

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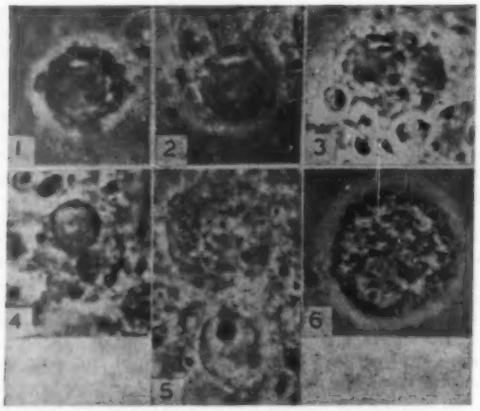
IT was pointed out previously that in the unstained living human spermatid the Golgi apparatus is sometimes discernible with bright-ground illumination, as an area slightly differing in refractive index from the remainder of the cytoplasm[1]. Recently, I have been able to confirm and extend these observations with the phase-contrast microscope. This instrument was of the phase-accelerating or positive type, so that dark and light regions in the image indicated higher and lower refractive indices, as a rule.



FIGS. 1–6 ARE UNRETOUCHED PHOTOMICROGRAMS OF LIVING HUMAN TESTICULAR CELLS TAKEN WITH A COOKE PHASE-CONTRAST SYSTEM, OBJECTIVE N.A. 1·30, MAGNIFICATION × 1,000, KODAK CONTRAST PROCESS ORTHO FILM. TRACINGS OF THESE FIGURES ARE GIVEN ON THE RIGHT AND INDICATE IN ADDITION STRUCTURES REVEALED BY CHANGE OF FOCUS

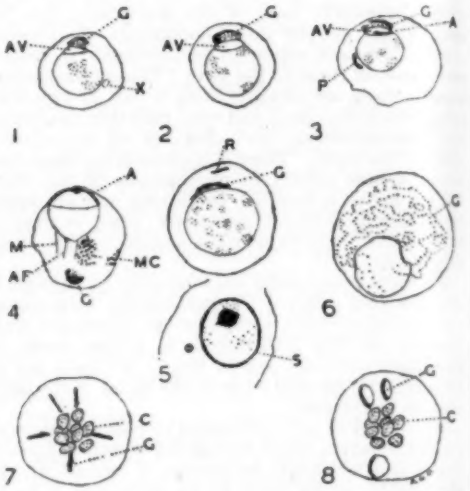
Figs. 1–4. Spermatids. Fig. 5. Primary spermatocyte and Sertoli cell. Fig. 6. Interstitial cell

Fresh testicular tissue was obtained from a European aged twenty-nine, at operation, and three Bantu, two aged twenty-eight and one aged twenty-three, less than half an hour after sudden and violent death. The biopsy specimen was preserved in plasma and also in Ringer-Locke solution, and the post-mortem material in pericardial fluid. Examination of the teased cells began within two or three hours after removal and extended over a period of ten hours.

In the earliest spermatids (Figs. 1 and 2), with phase-contrast microscopy, the acrosomal vacuole appears as a clear hemispherical space, slightly indenting the nuclear membrane. External to this lies a smaller dark hemisphere composed of a darker cortex and a lighter medulla. In some spermatids this cortex forms a continuous rind; in others it is interrupted and seems to consist of separate segments (Fig. 3). In older spermatids, the acrosomal granule and acrosomal cap can be seen within the acrosomal vacuole (Fig. 3). This vacuole gradually diminishes in size and, simultaneously, the dark bilaminar hemisphere comes to lie on its margin. In still later stages (Fig. 4), the acrosomal vacuole can no longer be seen, and the dark body, still composed of cortex and medulla, can be found lying free in the cytoplasm caudal to the nucleus, outside the area enclosed by the manchette.

Near the posterior region of the nucleus of the early spermatids, another dark cytoplasmic body is often evident (Fig. 3). This is probably identical with the postnuclear body. It has roughly the same size as the bilaminar structure already described, but it may be differentiated from it by its situation and the absence of two distinct zones.

It is relatively certain that the dark bilaminar body described in the spermatid is identical with the structure usually regarded as the Golgi apparatus in fixed tissue impregnated with silver or osmium tetroxide[2]. The body seen in living spermatids resembles the Golgi apparatus of impregnated spermatids in size, situation and behaviour, and such morphological differences as may be observed can quite easily be explained by known effects of impregnation[3].



FIGS. 7 AND 8 ARE DRAWINGS OF A SINGLE DIVIDING PRIMARY SPERMATOCYTE. FIG. 8 WAS DRAWN FOUR HOURS AFTER FIG. 7. *A*, acrosome and acrosomal granule; *AF*, axial filament; *AV*, acrosomal vacuole; *C*, chromosomes; *G*, structures presumed to be identical with the Golgi apparatus; *M*, manchette; *MC*, mitochondria; *P*, presumed to be the post-nuclear body; *R*, rodlet; *S*, Sertoli cell; *X*, artefact, an extra-focal image of an extracellular granule

In testicular cells other than spermatids definition of the Golgi apparatus is difficult, since in these cell types it presents fewer distinctive characteristics.[1] A Golgi element was not recognized in the few secondary spermatocytes examined, nor in cells undergoing second meiotic division. Near the nuclear membrane in primary spermatocytes (Fig. 5) a dark crescentic structure was observed, in which a dark cortex and thin inner medulla could sometimes be distinguished. In addition, a single straight rodlet was often visible in the cytoplasm. This rodlet may be an isolated dictyosome. In several cells undergoing the first meiotic division a number of similar rodlets were observed, lying outside the spindle area, quite distinct from the chromosomes. In one cell in Ringer-Locke solution these rodlets were first observed at the sixth hour after removal (Fig. 7). Four hours later

the cell was found to contain several lenticular vacuoles, each bearing a distinctly curved rodlet on one side (Fig. 8), very like dictyosomes. It is not certain that these are Golgi bodies, but they were quite unlike astral rays or mitochondria.

In the unstained spermatogonium the Golgi apparatus could not be satisfactorily distinguished from mitochondria, though occasionally a crescentic body like that of the primary spermatocyte was present. The Golgi element was not observed in living Sertoli cells.

In interstitial cells there was no evidence of a dark Golgi element; but a 'canalicular' network ramified through the cytoplasm (Fig. 6). This network is larger than the Golgi apparatus of impregnated interstitial cells, but has a remarkable similarity to the 'negative Golgi' which sometimes is produced in silver impregnations.

We may conclude, therefore, that with phase-contrast microscopy, in living testicular cells, structures are revealed which resemble the Golgi apparatus of impregnated cells. It would seem that no constant structure can be assigned to the Golgi element: it may appear as straight or curved rodlets, bilamellar crescents, or as a reticulum, depending on cell type.

Finally, it must be remembered that, invaluable as the phase-contrast method is in the study of living cells, interpretation of appearances will require experience and understanding, since spurious images are common (Fig. 1).

I am indebted to Dr. Jonathan Gluckman for the loan of the Cooke phase-contrast microscope used in these studies.

[1] Oettlé, A. G., *S. Afr. J. Sci.*, **37**, 239 (1940).
[2] Gatenby, J. B., and Beams, H. W., *Quart. J. Mic. Sci.*, **78**, 1 (1936).
[3] Baker, J. R., *Quart. J. Mic. Sci.*, **85**, 1 (1944).

PERMEABILITY OF THE MEMBRANES OF THE HEN'S EGG

By Prof. N. KLISSIUNIS
Biochemical Section, School of Hygiene, Athens

Permeability to electrolytes. Under normal conditions the membranes of plant cells are impermeable to electrolytes. But under abnormal conditions (transfer to solutions of pure electrolytes) the electrolytes can pass through (deplasmolysis). In this connexion, if one compares solutions of different electrolytes, one can observe that they follow the Hofmeister series. The series in which the hypotonic solution of electrolytes can cause hæmolysis of the red corpuscles is the same as the Hofmeister series. We have examined these conditions, using hen's egg membranes. According to the experiments of A. Orru[1], the permeability of the vitelline membrane to water was influenced by hydrogen and hydroxyl ions and by the presence of different electrolytes, and that complex ions can pass through as well.

We have examined fresh hen's eggs only a few hours old. In order to establish the permeability of the vitelline membrane to different neutral potassium salts, iso-osmotic solutions were prepared from potassium oxalate, phosphate, sulphate, chloride, bromide, iodide and thiocyanate at $-1{\cdot}45°$ C. of an approximate strength of 0·4/mol. The yolk of the egg, contained within an unbroken membrane, was placed in a flask and washed thoroughly with distilled water. 115 ml. were used to form the iso-osmotic solution for each experiment.

At the beginning of each experiment 15 ml. of the solution were extracted from the bottle for the examination of the content in anions of the salt. The bottle was kept throughout in a refrigerator at $+6°$ C. 5 ml. were taken from the bottle at forty-eight hours and after four days to determine if any fixation of anions had taken place through the yolk. By subtracting the values, which were found after forty-eight hours and four days, from the values of anion obtained at the beginning of the experiment, we could calculate the quantity fixed through the yolk. Also we found that albumin emerges from the yolk when this is in an electrolyte solution. This quantity of albumin was determined in the outer solution. To each 5 ml. of samples that were taken out of the flask, 1 ml. of 20 per cent trichloracetic acid was added. The filtered albumin precipitate was washed until the filtrate showed no detectable traces of the anion under test. The albumin precipitate was then dried at 105° C. and weighed. The determination of chloride, bromide, iodide and thiocyanate in the filtrate was carried out by precipitation methods. The sulphate was determined by the benzidine method, the oxalate through the oxidation method. For examination of permeability outwards the yolk was placed in 100 ml. of distilled water. The flask was also kept at a temperature of $+6°$ C. The chemical examination of the outer liquid after one, two and twenty-four hours has proved that the albumin reaction with sulphosalicylic acid and the reaction for chloride with silver nitrate was positive and had become far more positive twenty-four hours afterwards. For examination of the permeability of the cuticle we filled the shell with 20 ml. of a cold saturated solution of potassium ferrocyanide and we placed this shell in a cold saturated ferri-ammonium sulphate solution.

The volume of the yolk was increased in the iodide, thiocyanate and oxalate solution. Sometimes a bubble developed full of the liquid in the upper pole of the yolk and the yellow substance was repelled. The outside solution became either yellow or remained clear. The vitelline membrane after remaining for eight days in the potassium iodide solution became harder and split with difficulty. The internal substance became much more viscous. The fixation of anions in the yolk followed the Hofmeister series. The iodides were more fixed than their place in the Hofmeister series would allow. The oxalates were also more fixed, perhaps by damage of the membrane caused by calcium precipitation (see accompanying table). The diffusion of potassium ferrocyanide through the cuticle placed in a ferri-ammonium sulphate solution led to the formation of Prussian blue spots corresponding to the outer exits of the air tubes of the cuticle.

Anion	Anion fixed gm. % ml.		Albumin gm. % ml.
	48 hours	after 4 days	4 days
Oxal.	0·35	0·42	3·0
SO_4	0·04	0·12	0·49
PO_4		0·11	1·34
Cl	0	0·06	0·19
B_r	0·08	0·13	0·14
I	0·25	0·22	0·33
SCN	0·07	0·11	0·99

Permeability to electrolytes in the presence of narcotics. In these experiments, which were made chiefly with potassium iodide, the same materials and

methods were used as in the above, the only difference being that the outer solution instead of being pure salt solution was saturated with a narcotic. If we compare the above results with the pure potassium iodide solution and those with the same solution saturated with a narcotic, under the above-mentioned experimental conditions, we do not find significant differences in the fixation of iodine through the vitelline membrane. The differences found are within the range of the individual variations in the permeability of the vitelline membrane of different eggs. In the case of the albumin, in some of the above experiments but not in all, more of it was found in the outer solution than in an experiment with a pure water solution of the salt.

Thanks are due to Prof. Joachimoglu for advice during these investigations.

[1] Orru, A., *Biol. Abstr.*, **14**, 2, 211 (1940); *Chem. Zentralbl.*, **1**, 534 (1941); **2**, 1462 (1940).

EXCAVATIONS OF A ROMAN HOUSE

DR. FELIX OSWALD has now carried further the story of his years of excavation at Margidunum*. So little remained of the buildings of the first-century c vnp after the Roman demolitions in Hadrian's reign that at first the excavator seemed faced with a hopeless task; but by the painstaking investigation of every foot of the area concerned, down to the level of the undisturbed subsoil, the greater part of the plan of a building identified as the Commandant's House was revealed. Unfortunately, the eastern rooms of this house lie beneath the Fosse Way, which crosses the centre of the camp at this point, and possibly a hypocaust may lie buried here, as none was found elsewhere.

The usual sequence of two buildings, one of timber and one of stone, was found, the first dating from the time of the foundation of the camp by Ostorius Scapula in A.D. 48, and destroyed during the Boudiccan rebellion, and the second erected, after the lapse of a few years, during the reign of Vespasian or Titus, and remaining in use until the end of the occupation of the camp. The surviving post-holes were too few for the plan of the timber building to be recovered, but the plan of the later house is of a type allied to that of houses known from other forts, and several of the plans of these are illustrated, drawn to the same scale for purposes of comparison. Stables may have existed to the north of the house, and an interesting feature is a pit contemporary with the timber building, which in view of a parallel at Hofheim, the excavator thinks may have been used for preserving oysters in salt water.

The major part of the report is devoted to the description, discussion and illustration of the pottery found on the site. The Terra Sigillata showed no very unusual features; but among the coarse wares of the earliest phase (Claudius–Nero), a large storejar with an impressed stamp of three stars above two rosettes on its lower half was an unusual discovery, and it is suggested that this may indicate a measure of quantity. The coarse ware of the succeeding phases shows considerable development, and includes frequent imitations of Terra Sigillata forms. Evidence was also found showing that some of the pottery of Vespasianic date was made at the Castor potteries. Any discoveries which help to tie down the dating of the products of these potteries are of particular interest owing to their increasingly widespread distribution. Altogether this report makes important additions to the mass of valuable comparative material with which Dr. Oswald has already provided us.

* The Commandant's House at Margidunum. By Dr. Felix Oswald. Pp. 41 (17 plates). (University College, Nottingham, 1948.) 7s. 6d.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

ANNUAL CONGRESS, 1948

AT the invitation of the Mayor and the Corporation of Great Yarmouth, and with the co-operation of the Great Yarmouth Naturalists' Society, the South-Eastern Union of Scientific Societies held its fifty-third annual congress during June 14–19 at Great Yarmouth, under the presidency of Mrs. Jacquetta Hawkes. The Mayor, in his welcome to the Congress at the Town Hall, where accommodation was provided for meetings by the Corporation, said that those who were not versed in 'old buildings' could not appreciate the beauty of them, and that societies such as he was addressing opened the eyes to the reasons why such old buildings as these on the South Quay at Yarmouth should be preserved. Capt. Dannreuther inducted the president, and congratulated her upon being the first lady to hold the office since the foundation of the Union more than fifty years ago.

Mrs. Hawkes, in delivering her address upon "Archæology and the Present", said that two world wars had disturbed the faith in the certainty of progress in a way resembling the questioning of the story of Genesis by the theory of evolution. She believed that archæology provides a sense of comfort by comparisons, such as life in a palæolithic cave with life at Versailles or the compositions of Beethoven. The popularity of the subject is perhaps due to the solace obtained from the study of the solidity of the past compared with the flimsiness of the present and the uncertainty of the future. An education based on classical studies has been a great force in Britain, and it is of utmost importance to salve what is valuable and to adapt it to the changing conditions. Archæology can play its part by saving classical studies from exclusiveness and isolation. It can add intimacy and humanity to the classics to make them acceptable to a greater number.

Mrs. Hawkes said she believes that if the archæological method, in the widest sense of the study of material things through all the periods, can become an accepted part of teaching, the distaste of people of all classes for vulgar architecture and badly designed utensils would lead to an improvement of our environment and thus to the general betterment of all. Archæology could display a vast array of cultures which would help us to decide how to search for new values and to teach us that mechanical gadgets are not essential to the fulfilment of valuable lives.

The Archæological Section of the Union was addressed by its president, Lieut.-Colonel S. E. Glendenning, on "Local Materials and Craftsmanship in Norfolk Buildings", and a paper on "Roman Britain as seen in the Yarmouth Neighbourhood" was read by Mr. P. E. Rumbelow, who also conducted

an excursion to the Roman Station at Burgh Castle.

Mr. H. J. Howard delivered the presidential address to the Botanical Section on "The Mycetozoa of Sand-dunes and Marshland", and Mr. F. O. Whitaker's paper on "The Botany of the Cromer Forest Bed" was read. Joint excursions, with the Zoological Section, were conducted to Fritton Lake, Wheatfen Broad and Norwich.

The Geological Section elected Mr. C. D. Ovey as president, and his address was upon "Foraminifera in Stratigraphy with special reference to the Ecology of Living Forms". A paper was read on "The Geological and Archæological Problems of the Red Crag" by Mr. S. Hazzledine Warren, and Mr. J. E. Sainty gave a paper upon "The Geology of Norfolk". He also arranged and conducted successful excursions to the Norwich and Cromer areas in illustration of his views upon the formation of the district.

The Zoological Section's presidential address was given by Major Maxwell Knight on "The Study of Bird Pellets as a Subject of Interest and Instruction to Amateur Naturalists". A paper was read by Dr. Malcolm Smith on "Some Undetermined Points in the Life-Histories of the British Reptiles".

An evening conversazione was arranged by the Great Yarmouth, Lowestoft and Norwich Naturalists' Societies. A very successful Young Naturalists' evening was held at the Town Hall. Coloured Nature films, specially taken at the London Zoo by Mr. Douglas Fisher, were exhibited. The commentary on the first two, dealing with snakes, lizards, newts, frogs and toads, was given by Dr. Malcolm Smith, and that on the third, concerning the behaviour of the tarsier, was given by Major Maxwell Knight. The remainder of the evening was devoted to a naturalists' brains trust, the arrangements for which were in the capable hands of Major Maxwell Knight, who also acted as question master. His 'brains' were: Capt. T. Dannreuther, Mr. E. A. Ellis, Mr. David Seth-Smith and Dr. Malcolm Smith. Questions were selected from those sent in by schools in the area, a request having been made that they should be debatable rather than factual. Although admission was limited by the issue of tickets, more than a hundred additional young people got into the hall, which, besides giving encouragement to the organisers, should also give hope to those whose theme is the rejuvenation of the local natural history societies. The question master suggested to the delegates present that each of the seventy societies affiliated to the Union might, with advantage, arrange similar evenings.

After the general assembly, the discussion on "The Functions and Organisation of Local Societies", in continuation of that initiated by the British Association, was opened by Mr. G. Gosnell.

The next congress of the Union will be held at Canterbury during Easter 1949.

SMITHSONIAN INSTITUTION

ANNUAL REPORT

THE report of the Secretary of the Smithsonian Institution, Washington, D.C., for the year ended June 30, 1947, which includes reports on the newly established National Air Museum and on the Canal Zone Biological Area, recently placed under the administration of the Institution, records the resumption and, in some directions, expansion of much of the normal research and field-work suspended during the War. Accessions to the National Museum are back to pre-war levels, and the International Exchange Service has considerably reduced the accumulation of material for foreign exchange built up during the war years, and the service will soon be again on a current basis. The two greatest needs of the Institution are additional staff and more building space.

Under the Canal Zone Biological Area Advisory Board, a wide range of studies and tests has been carried out under tropical conditions. Those in progress include an extensive organisation for testing the proofing of wood to termites, the tropical deterioration of plywoods, textiles, and packaging containers, and the effect of fungi on optical glass. Some four hundred publications have been issued on research carried on here in entomology, forestry and medicine with special reference to the control of termites, fruit flies and mosquitoes.

Appended to the secretary's report is the Financial Report of the Executive Committee of the Board of Regents, as well as separate reports on the National Museum, the National Gallery of Art, the National Collection of Fine Arts, the Freer Gallery of Art, the Bureau of American Ethnology, the International Exchange Service, the National Zoological Park, the Astrophysical Laboratory, the National Air Museum, the Canal Zone Advisory Board, the library and publications.

The report from the National Museum refers to the resumption of investigations of fifteenth-century historic Indian village sites and some of the early Spanish settlements in the West Indies, to the continuation of the survey of the fishery resources of Guatemala, a botanical survey of St. Vincent, and to field work on the lower cryptogams as part of a biological survey of the Patuxent Research Refuge. Systematic researches under the Bureau of American Ethnology recorded during the year include the River Basin Surveys, aimed at recovering such archæological and palæontological information and materials as will be lost through the construction of dams and creation of large reservoirs in many of the river valleys of the United States. Papers prepared for publication deal with the State names of Mexico, the province names of Canada, and the detailed ethnographical description of the projecting rocks and islands off the coast of California, while a bibliographic project has been initiated having as objective the compilation of an annotated, fully indexed bibliography covering the descriptive, geographical and other scientific literature on the Arctic from the earliest historical writings to those of the present time. A roster of Arctic specialists is also being compiled which will afford a comprehensive record of the experience and specialized knowledge of scientific men, explorers, writers, and Arctic residents who possess first-hand information of value concerning the Arctic and sub-Arctic regions. A joint expedition with the National Geographic Society made an archæological survey of the Pacific coast of the State of Chiapas, Mexico, and the Viru Valley Expedition attempted to survey thoroughly a single valley of the Peruvian coast as a living unit through some three thousand years, including archæological, geographical and modern community studies.

The report on the National Zoological Park, in addition to listing accessions during the year, gives a complete list of animals in the Park at June 30,

1947. At the Astrophysical Laboratory, the Division of Astrophysical Research has been concerned mainly with appraising the solar-constant values received from its field stations and planning and developing improvements in instruments and methods. Eighteen months of continuous measurement of sun and sky radiation have been completed at Camp Lee, Virginia, and the work is being extended to include measurements and exposures at a wet, sea-level and a dry, high-altitude station. The Division of Radiation and Organisms was concerned with the role of light, especially the wave-length effects on the fixation of carbon by green plants, and with the mechanism of dormancy in seeds sensitive to light and the study of the developmental physiology of grass seedlings. A critical review of the literature dealing with the germination of lettuce seed is in preparation, and studies are in progress on the identification of volatile substances responsible for inhibiting the germination of several species of seeds.

The report on publications lists the titles of twenty-six papers in the Smithsonian Miscellaneous Collection, twenty-two in the general appendix to the Smithsonian Annual Report, and three bulletins from the National Museum.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Monday, July 12—Saturday, July 17

SOCIETY OF CHEMICAL INDUSTRY (at the Assembly Rooms, George Street, Edinburgh).—Annual General Meeting.

Wednesday, July 14

At 9.45 a.m.—Sir John Anderson, F.R.S.: "Science in relation to the Public Services".

Thursday, July 15

At 9.45 a.m.—Sir Robert Robinson, F.R.S.: "The Device of Imitation of Molecules in the Biological Field" (Lister Memorial Lecture).

Wednesday, July 14

ASSOCIATION OF OPTICAL PRACTITIONERS (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 2 p.m.—Dr. Matthew Luckiesh: "Factors Concerned in Vision, Light and Seeing".*

Wednesday, July 14—Friday, July 16

PHYSICAL SOCIETY, ACOUSTICS GROUP (joint meeting with the ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 66 Portland Place, London, W.1), at 10 a.m. and 2.30 p.m. each day—International Conference on "Noise and Sound Transmission".

Wednesday, July 14

At 10 a.m. and 2.15 p.m.—"Sound Transmission".

Thursday, July 15

At 10 a.m.—Papers of Architectural Interest.

Friday, July 16

At 10 a.m.—"Measurement of Noise and Vibration"; at 2.30 p.m.—"Applied Acoustics".

Saturday, July 17

NUTRITION SOCIETY (in the Barnes Hall, Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 10.30 a.m.—Conference on "The Nutrition of Athletes".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN PHYSIOLOGY (Grade I or II)—The Secretary and Registrar, The University, Bristol (July 17).

ASSISTANT LECTURER (Grade III) IN THE DEPARTMENT OF PHYSICS—The Registrar, The University, Liverpool (July 17).

UNIVERSITY LECTURER IN BOTANY, to lecture on Mycology or Mycological Plant Pathology—The Secretary, Faculty of Biology "A", Department of Zoology, Downing Street, Cambridge (July 17).

LECTURER IN PHARMACOLOGY—The Registrar, The University, Leeds 2 (July 17).

CHEMIST or PHYSICIST for testing of refractories, a PHYSICIST for physical work connected with gasworks practice, a CHEMIST or PHYSICIST for abstracting, collating and reporting from technical literature, and a CHEMIST to join research staff dealing with problems connected with gas manufacture—The General Manager and Secretary, City of Birmingham Gas Department, The Council House, Birmingham 8 (July 19).

LECTURER IN SURVEYING for Department of Civil Engineering—The Secretary, University College, Gower Street, London, W.C.1 (July 23).

SENIOR LECTURER IN MATHEMATICS in the Department of Aerodynamics—The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks, marked 'Senior Lecturer in Mathematics' (July 24).

LECTURER IN BIOCHEMISTRY for the Department of Physiology—The Secretary, Royal (Dick) Veterinary College, Summerhall, Edinburgh 9 (July 26).

SENIOR LECTURER or LECTURER IN BOTANY for the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 8 Park Street, London, W.1 (July 31).

PROFESSOR OF BOTANY at Rhodes University College, Grahamstown, South Africa—The Secretary, Universities Bureau of the British Empire, 8 Park Street, London, W.1 (July 31).

ASSISTANT DIRECTOR OF RESEARCH with practical experience of computation to work in the Mathematical Laboratory, and a UNIVERSITY DEMONSTRATOR whose primary interest is statistics—The Secretary to the Appointments Committee, Trinity College, Cambridge (July 31).

SENIOR LECTURER or LECTURER IN ANATOMY (Histology)—The Registrar, The University, Sheffield (July 31).

KEEPER OF ANTIQUITIES—The Director, Museum and Art Gallery, New Walk, Leicester (August 30).

CHAIR OF APPLIED MATHEMATICS—The Registrar, University College, Southampton (September 20).

AGRICULTURAL EDUCATION ADVISER—The Secretary for Education, County Buildings, Shrewsbury.

ASSISTANT LECTURER and DEMONSTRATOR IN THE PHYSIOLOGY DEPARTMENT—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

CURATOR at the Municipal Museum—The Town Clerk, Town Hall, Tunbridge Wells, Kent.

LABORATORY STEWARD at the College, Swindon—The Borough Education Officer, Education Office, Civic Offices, Swindon, Wilts.

LECTURER IN BIOLOGY—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex.

LECTURER IN BIOLOGY in the Senior Technical College—The Principal, Technical College, Luton, Beds.

LECTURER IN CHEMISTRY for Science Department, Municipal Technical College—The Director of Education, Education Office, St. Helens, Lancs.

LECTURER IN MATHEMATICS (male)—The Principal, Acton Technical College, High Street, Acton, London, W.3.

METALLURGIST to take part in investigations on casting of ingots and on ingot mould design and performance—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1.

METEOROLOGICAL FORECASTERS for the East African and West African Meteorological Services—The Director of Recruitment (Colonial Service), 15 Victoria Street, London, S.W.1.

PHYSICIST or CHEMIST to undertake research on adhesional and related properties of rubber, and a PHYSICAL CHEMIST to undertake research on latex—The Research Association of British Rubber Manufacturers, 105 Lansdowne Road, Croydon, Surrey.

RESEARCH FELLOWSHIPS (2) IN EDUCATION, within the Institute of Education—The Secretary, The University, Edmund Street, Birmingham 3.

SENIOR ASSISTANT IN THE ENGINEERING DEPARTMENT, County Technical College, Wednesbury—The Director of Education (Dept. F.E.), County Education Offices, Stafford.

SENIOR LECTURER in component and detail STRESSING OF AIRCRAFT STRUCTURES in the Department of Aircraft Design—The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks, marked 'Senior Lecturer in Aircraft Stressing'.

TECHNICIAN FOR THE DEPARTMENT OF PHYSIOLOGY AND PHARMACOLOGY—The Secretary, St. Mary's Hospital Medical School, Paddington, London, W.2.

TIMBER MARKETING OFFICER by Government of Nigeria, Commerce and Industries Department—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/N/17860/3E.

LECTURER IN CHEMISTRY and a LECTURER IN PHYSICS—The Principal, County Technical College, St. James's Road, Kingston-upon-Thames, Surrey.

LECTURER IN CIVIL ENGINEERING—The Director, Robert Gordon's Technical College, Aberdeen.

LECTURER IN MATHEMATICS and a LECTURER IN CHEMISTRY for Municipal Technical College—The Director of Education, Education Offices, Library Street, Blackburn.

LECTURER IN MECHANICAL ENGINEERING—The Principal, Handsworth Technical College, Golds Hill Road, Handsworth, Birmingham 21.

LECTURER IN MECHANICAL ENGINEERING—The Principal, Technical College, Queen Street South, Huddersfield.

LECTURER IN PHYSICS—The Principal, Birmingham Central Technical College, Suffolk Street, Birmingham 1.

LECTURER IN PHYSICS—The Clerk to the Governors, Chelsea Polytechnic, London, S.W.3.

SENIOR ASSISTANT LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING—The Principal, Borough Polytechnic, Borough Road, London, S.E.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Other Countries

Government of Palestine: Board of Scientific and Industrial Research. Problems of Heat Physiology in Palestine. Report to the Colonial Medical Research Committee by Dr. W. S. S. Ladell. Pp. 2 100 mils; 2s. Survey of Literature on the Influence of Ions on Plant and Soils. Compiled by Dr. A. Mibashen. Pp. 46. 200 mils; 4 (Jerusalem: Board for Scientific and Industrial Research, 1948.) [1